NOTES
ON METHODS OF FILLING TEETH WITH GOLD INLAYS

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PREFATORY NOTE

THESE notes on gold inlays now offered to my confrères have been the outcome of clinical demonstration presented before Dental Society meetings ever since the earliest attention given to this system of filling teeth.

I was prompted by the feeling expressed at the time that this principle possessed an available means of restoring lost tooth tissue, and also preventing the ravages of dental caries.

The fulfillment of this principle of filling teeth, as advocated by the early pioneers of this work, has now become fully recognized by the profession as an additional acquisition to our selection of filling materials.

In the following articles I have endeavored to deal with the subject from as practical a standpoint as possible, by describing the various phases of inlaying methods, for I am confident that the highest conception of this principle of filling teeth must be attained through the different methods now in vogue and not confined to any one alone.

The author, in writing on such a technical subject, is aware of the constant changes that are likely to follow, but will submit the contents of this volume to the reader, in the hope that some aid will be given to inlay operations.

T. C. T.

St. Thomas, Ont., Canada,
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NOTES
ON METHODS OF FILLING TEETH WITH GOLD INLAYS

ADVANTAGES OF GOLD INLAYS

IN advocating the principles of filling teeth by a process of inlaying with gold, and their utility as a means of preserving and restoring tooth structure, I am assured of their practicability, from results obtained by considerable experience, by adapting this method of filling teeth, and by the advancing popularity of this branch of operative dentistry.

The restoration of the lost portions of the teeth by means of inlays is as old as the art of dentistry itself; but as new adaptations of old processes are frequently appearing, I need make no apology in presenting the subject as it has appeared to me in a practical way. It is not intended that the insertion of gold inlays shall replace any of the former methods of filling teeth that have been of value, but rather it should supplement them. Gold inlays have been greatly used in very large cavities in bicuspids and molars, the walls of which are too frail to support ordinary gold fillings, although they are applicable to almost any cavity. They have been widely used in dental practice and are considered beyond doubt one of the greatest factors in preserving tooth structure.

Advantages of Gold Inlays.— The insertion of gold inlays prevents, to a great extent, the vast destruction of the enamel when gold crowns are used, and the recurrence of decay in large cavities filled with amalgam.

The construction of fillings by means of gold inlays does away with the tedious operation of inserting cohesive gold, minimizing, also, the severe physical strain on the patient, and no less trying strain on the operator, as many times experienced where considerable contour restorations are required, in large compound cavities; so that rather than submit to such a task it is relinquished, causing one to yield ofttimes to the use of more unsightly and less beneficial material, such as amalgam or the substitution of a gold crown.

By the use of the gold inlay the difficulty of the scaling of the gold, as not infrequently occurs on large contour restorations when cohesive gold fillings are used, is overcome, as the inlay is made of one soldered mass with no possible destruction of the contour in the act of attrition.

It is not advisable to entirely discard the use of the rubber dam, but in many instances its use is not necessary, as the moisture can be sufficiently excluded by the use of the napkins and various other means to properly construct the matrix and allow time for the setting of the inlay. As it is seldom necessary to use the rubber dam for inlaying, this method of filling teeth is appreciated by our patients, as it avoids the use of this very objectionable attachment.

The manipulation of cohesive gold requires considerable force for the operation of welding, and not infrequently the thinner walls become broken, but by the inlaying process this seldom occurs. The use of cement as an intervening substance, to hold the inlay in the cavity, prevents thermal changes occurring on the sensitive dental tubuli and its evident obtunding effect upon hypersensitive dentin, for ofttimes in deep cavities filled with cohesive gold this difficulty cannot be overcome, as the gold is forced in contact with those sensitive portions of dentin, causing many times considerable discomfort after filling and also affecting the vitality of the pulp.

The "lining" of cement on thin, frail walls increases their strength, and thereby lessens the danger from fracture and also prevents discoloration of these parts when cohesive gold is used.

If the inlay should become dislodged, perchance, by improper manipulation of the cement or from subsequent decomposition, or the inability to exclude moisture while setting the inlay, it can be recemented without any difficulty; and from vast experience in the setting of gold inlays, I find this the least troublesome feature.

According to observations of porcelain inlay operators, caries seldom occurs around such fillings, and the same fact holds good when gold inlays are used; this fact is due, no doubt, to the close adaptation of the inlay margins to the edge of the cavity and their still closer adaptation by burnishing, thereby excluding the moisture from permeating to the cement beyond. Recurrence of decay frequently occurs with cohesive gold or amalgam fillings, but this seldom happens when gold inlays are used. Where considerable separation exists between the teeth, especially in molars and bicuspids, this difficulty can be overcome by contour extensions on inlays, whereas by other fillings it has its limitations. Owing to the lower quality of the gold used in inlays, they resist the action of mastication far better than fillings made of pure gold.

Another good advantage of filling teeth with gold inlays is that it reduces considerably the amount of operating on the patient required when inserting cohesive gold.

It need not be necessary to complete the whole operation at one appointment, but the remaining portion thus to be completed may be left to a subsequent sitting.

The many merits that gold inlays possess, that have been enumerated, should be sufficient to justify their employment.

PREPARATION OF THE CAVITY AND CAVITY EDGES

In preparing a cavity to receive a gold inlay, the same care should be exercised in removing all decay and infectious dentin, and a thorough preparation of the cavity edges, as though it was to receive a gold filling.

A cavity for the reception of a gold inlay differs from that of a gold filling, inasmuch as no undercuts are necessary, and when the matrix is swaged and burnished in place it can be withdrawn easily, so as not to change its form.

In preparing a cavity for an inlay there are several requisites:

1. The cavity must possess such depth as will admit of good anchorage.
2. The cavity edges should be thoroughly prepared.
3. The matrix must be easily adapted to the margins of the cavity.
4. The cavity should be so prepared that an impression can be taken with accuracy.
5. Thorough access must be had for its insertion. (See Fig. 1. a, b.)
6. There must be good retention.

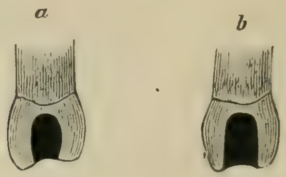
In commencing the operation for inlay work, first cleanse the cavity of all decay. It is impossible in deep cavities to stretch the matrix metal to its full depth, but by using a core made of cement and filling in as the depth of the cavity will allow and extending it across the whole floor and base of the cavity so as to give a somewhat flattened surface, the danger of destroying the matrix in the act of swaging and burnishing, or in taking an impression of the cavity, will be greatly lessened, and the material can be better adapted and withdrawn so as not to affect in the least its shape. The use of an intervening substance of this kind will prevent the unnecessary extension of the matrix to the base of the cavity, and at the same time minimize the amount of gold for contouring. If undercuts exist, they should be filled so as to allow an easy removal of the matrix.

In saucer-shaped cavities make abrupt walls.

In preparing the margins of the cavity remove any overhanging portions, thereby making a uniform line throughout.

Angles must be cut away and converted into curves, and straight lines must not terminate too abruptly in short curvatures. Cut the edges straight and avoid beveling. Of course, it is advisable not to have the edges terminate too sharply, as in the act of swaging the matrix would be cut and in consequence destroyed.

FIG. 1.



The edges of the cavity should be thoroughly prepared by using suitable burrs, fine polishing stones and cuttle-fish disks. It is well to exercise considerable care in polishing the cavity edges, as it will result in giving the inlay a better finished appearance, although if they are not definitely defined, the matrix may be forced by vigorous burnishing to all depressions that may exist on the cavity edges.

If the marginal edges of the cavity are too sharp, the matrix will be torn in the act of swaging; and, if this occurs, remove the matrix, polish the parts that are defective and then reburnish. Do not attempt to use a matrix that is torn at the marginal edge. To successfully accomplish the operation of swaging and burnishing, thorough access must be had for its insertion, so as to force the matrix to all parts of the cavity and to admit of easy removal when it is ready to be "teased" therefrom, or when an impression of the cavity is needed it should be easy to withdraw, without affecting its shape.

In proximal cavities care should be taken to have sufficient separation, if they do not include the morsal surfaces, so that the matrix may be formed and withdrawn easily from the cavity. When two compound proximal cavities are in contact, the smaller one should be formed first, for in the larger one the cavity is more accessible for forming and withdrawing the matrix.

Sometimes it is advisable to make the matrix in two parts, as by so doing it will lessen the liability of tearing and wrinkling the matrix, and thus make it easier to adapt to the margins of the cavity.

In making retaining grooves on the margins, cut them sufficiently wide so that the matrix can be burnished to all its surfaces, as in narrow or constricted ones it is impossible to force the matrix to all its parts accurately.

Do not attempt to form a matrix when one side of the cavity forms an open space and the other comes in contact with the adjoining tooth, as by so doing it will not allow an easy adaptation of the matrix in that situation, and when inserting the inlay does not give enough space, nor would it be possible to polish the edge successfully.

Cutting the enamel freely, bucco-lingually in molars and bicuspids, will give an easy access into the cavity, so as to allow for forming the matrix and also give sufficient space for the insertion of the inlay.

The preparation of the cavity for the reception of an inlay will greatly depend upon its area and depth, for in large compound cavities a greater space may be obtained for attachments, as in these cavities the use of an intervening material, such as cement, prevents the matrix from being stretched to the full extent and base of the cavity, and also gives a means for attaching extensions to the matrix for retentions, such as loops, pins, or posts.

In such cavities of lesser depth, the matrix can be forced to the full extent of the cavity, and in these cases the retention is made by roughening, grooving, hollowing, or countersinking on the matrix surface of the inlay. The greater these depressions are made the greater will be the security for retention. It therefore follows that the greater is the cement area the greater will be the anchorage of the inlay.

The system of dovetailing, used in cohesive gold operations, for retention is very applicable in proximo-occlusal surfaces of gold inlays, as when so formed they cannot be dislodged by occluding force when the inlay is in position before cementing.

In shallow cavities of limited depth the matrix is forced to the base of the cavity and the amount of retention depends upon the hold the cement has on extensions made in the inlay and also upon the use of undercuts so as to increase the retaining power of the cavity walls.

Gold and platinum are the two metals used for making matrices. The former is used more frequently, and owing to its great malleability, ductility, and comparatively high fusing-point, is very available for the making of gold inlays, while the latter, not possessing so many good qualities as the former, excepting in a higher fusing-point — melting only at the highest attainable temperatures — is less used for making matrices in the process of inlaying with gold.

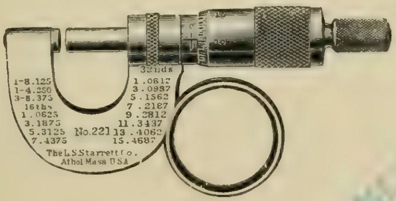
The thickness of gold to be used for matrices will be determined by the amount of swaging required, for in deep cavities involving large surfaces, thicker gold should be used, and for shallower ones, a thinner foil. Pure gold must be employed for matrices. This can be obtained from supply houses in sheet form, but as it is usually supplied in one thickness, it is consequently not adaptable to all cases. A good mill for rolling the metal is a very essential appliance in the laboratory, as it can be frequently used to advantage, according as the case presents itself, to obtain the correct gauge of metal required. The mills should be accurately adjusted, so as to produce an even surface throughout when the metal is rolled sufficiently thin; the failure to observe this point yields very unsuitable results when swaging and burnishing the matrix.

While pure gold can be supplied in sheet form, it can also be obtained by melting old gold fillings heated on a lump of charcoal and fused by means of a mouth blow-pipe. I may state here that the mouth blow-pipe should be used throughout the whole operation of inlay work, as the operator can obtain better results than with other appliances.

To successfully accomplish the operation of rolling the metal it should be passed through the mill always in the same direction. By so doing better results can be obtained, as wrinkling is prevented and a more uniform surface secured. To increase the width of the metal, adopt the same method, passing it through in the same manner. Before changing the direction of the metal as it passes through the rolls, always anneal, as the material is thus better controlled and very much easier to manipulate.

Owing to the thinness of metals used for forming matrices, the standard wire gauge is not applicable for measurement, but a one-half inch standard micrometer (Fig. 2) gives an accurate gauge of the materials employed; although after considerable experience one can determine the thickness without the aid of this instrument.

FIG. 2.



The extent to which the matrix material is to be stretched will be determined by the size and depth of the cavity. For large, deep, cavities, a thicker gold should be used, namely, .002 gauge, and for shallow ones, .003 gauge. If the gold is too thick it is very difficult to manage, and consequently this should be avoided, and thinner golds are liable to tear and become distorted on their withdrawal. Cut the gold in convenient sizes, two inches long by one-half in width. After the final act of rolling do not anneal until required, as when annealed in large sheets, such thin metal is liable to become wrinkled and its working qualities injured. The metal to be used for the matrix should be cut large enough to allow for stretching and lapping over the margins of the cavity and then annealed before swaging.

Pure gold fuses at 2000° F., and the extent to which it should be heated in annealing is, of course, much below this. If, when held over a Bunsen burner, it assumes a cherry color, the gold will be found very soft. This quality will be increased by plunging it in cold water. If four parts sulphuric acid be quickly added to one part of water, a notable elevation of temperature takes place, for the energy of the combination of the water is so great that heat is evolved. This mixture, when gold is heated and thrown into it, not only has an annealing action, but an increased cleansing quality.

As platinum melts only at the highest temperature, for annealing purposes a white heat is required. This can be obtained by placing the metal in an electric porcelain furnace. This procedure applied to platinum foil, for matrices in porcelain work, will considerably lessen its rigidity in swaging and burnishing. After swaging, and before final burnishing, I consider it advisable to again anneal the foil, as thereby the manipulation is made much easier.

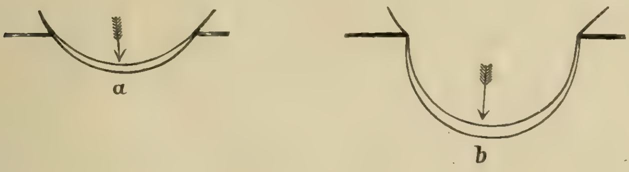
The most practical flame for the melting process, and casting the inlay by means of solder, is to obtain an ordinary adjustable gas jet and remove the tip; this I consider beyond doubt the best heat to use, and the amount of flame can be regulated by the stopcock. Use the mouth blow-pipe slightly above the jet, and by proper regulation of the flow, any necessary degree of heat can be obtained.

FORMING THE MATRIX--DIRECT METHOD

In order to obtain an accurately fitting inlay, it is absolutely necessary to have a perfectly formed matrix. There are two methods of forming the matrices. One way to form the matrix is to directly swage it into the cavity by instrumentation; the other method to construct the matrix is by the use of the die and counter-die. The preparation of the cavity edges for the employment of either of these methods is the same. It is also very essential to have free access into the cavity, so as to accomplish the operation of swaging, burnishing, and withdrawing the matrix from the cavity or the taking of an impression to obtain the die and counter-die.

In selecting the matrix material, as regards thickness, much will depend upon the size and depth of the cavity, and also the amount of filling substance at the base of the cavity, for in large compound cavities of extended depth, a thicker matrix should be used, as in the act of swaging and burnishing it undergoes considerable stretching before it is forced to all parts of the cavity, and the matrix is considerably lessened in thickness toward the extreme base, whereas in cavities of limited area a more uniform gauge of the matrix is maintained, and in consequence of this, a thinner matrix material may be used. Fig. 3, a and b, shows the extent of stretching of the gold in deep-seated cavities.

FIG. 3.



After making a choice of metal to be used for the matrix, either of gold or platinum, cut a piece considerably larger than will cover the cavity and at the same time allow enough for swaging. The next operation for the formation of the matrix will be for the adaptation to the base of the cavity and cavity edges, by swaging it directly into the cavity with the use of swagers and burnishers. Frequently the matrix can be pressed and burnished in the cavity without the necessity of previously obtaining a die.

Various materials have been used for pressing the foil against the walls of the cavity, for example, cotton, small pieces of chamois, spunk, and also instruments pointed with rubber attachments. In deep cavities, extending beyond the gingival margin, the metal should be formed somewhat to the shape of the tooth in that situation and then forced gently between the gum and the tooth, so as to extend a few lines beyond.

In extra deep cavities, where it is impossible thus to extend the matrix foil, the extreme base can be filled in with amalgam sufficiently so as to overcome any possibility of the matrix being defective in that situation, and also to make it easier of adaptation to the remaining portion of the cavity. It is advisable, in large compound cavities in molars involving more than one surface, to make the matrix in two pieces. This will prevent the buckling of the gold and facilitate a correct adaptation to the cavity. Before applying the matrix foil to the cavity it is necessary to thoroughly anneal, as by so doing it will be more easily forced and burnished in place. In commencing the operation of swaging and burnishing the matrix, care should be taken, especially in deep cavities, to force the foil toward the deeper portions, as so doing will save extra stretching of the matrix, and lessen the liability of tearing when it undergoes further swaging and burnishing. After this is done, again swage with light pressure, then remove, and approximately trim so as to extend a few lines over the edge of the cavity. Finally, the matrix is adapted in place by means of a universal swager in conjunction with various shaped rubbers, consisting of rings, cones, and blocks.

The Universal Matrix Swager (Fig. 4) which I have devised is used to force the rubber forms into the cavity, either by the pushing or drawing motion; it has two blades, of slight concavity, so as to give a grip to the rubber forms to lessen the possibility of slipping. One blade is longer than the other and will accommodate the forms to any depth cavity. The blades are very rigid, and are made thin so that they will pass without any difficulty in the separations made between the teeth. This swager is also applicable for holding inlays in place while the cement is setting, or in setting a crown it may be used for the same purpose. The various rubber forms may be obtained at rubber emporiums and can be so cut as to suit the requirements; some are thickened tubing, and these can be cut of sufficient length so as to slip over the blades, and thus give security in the act of swaging. To overcome the difficulty of dislodging the matrix while swaging, a thin piece of rubber is forced between the teeth towards the cervical margin, or a small portion of soft vulcanite, it being rather better adapted for that purpose as it conforms itself easier to that situation. Fig. 5 shows Duffield's matrix swagers which are mounted with different size rubber forms, being very adaptable for swaging the matrix to the extreme depth of the cavity. There are other materials that are used to advantage for swaging in juxtaposition to the matrix, for example, cotton, soft chamois leather, and spunk, which may be swaged with a suitable flat burnisher.

FIG. 4.

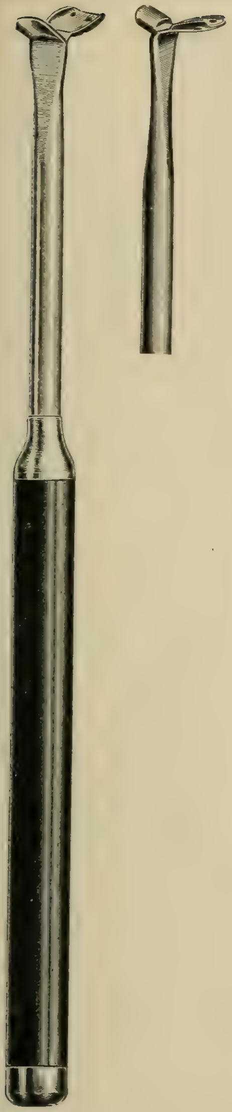
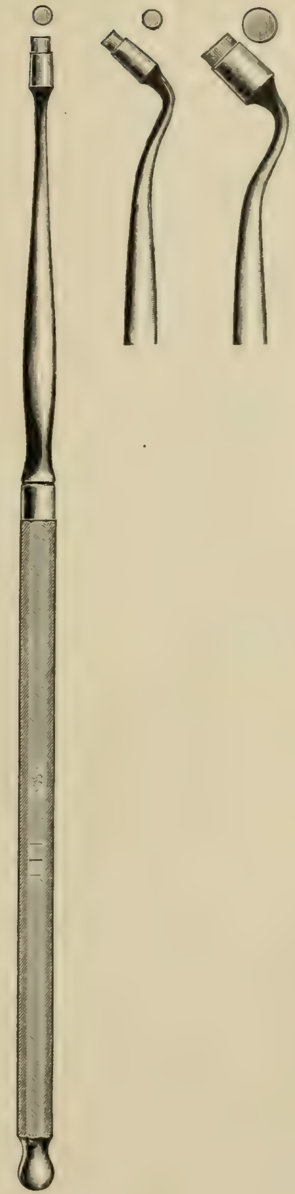


FIG. 5.



Care should be taken to force the matrix to all parts of the cavity before commencing to burnish the edges, and the matrix should extend at least two lines over the edge of the cavity, for any attempt to form an inlay that falls short of covering the marginal edges will render it defective in that situation, and it is good advice, if this occurs, to discard at once this matrix and select a piece of gold somewhat larger so as to overcome this difficulty. Pieces of wet cotton forced between the matrix and the adjoining tooth, to press the matrix into apposition with the cavity walls, are also used to advantage, in conjunction with an orange-wood point attached to the mallet. If any tears should occur beyond the marginal edge into the cavity, this defect can be easily remedied subsequently by the application of small pieces of pure gold before the final act of soldering.

Some operators prefer, after swaging the matrix, to remove it from the cavity and thicken with 22-k. solder, as by so doing the matrix is stiffened and distortion in its removal from the mouth is prevented. If this means of stiffening the matrix be used, care should be taken to apply but very little solder, as a small amount well distributed will allow of sufficient rigidity to make it still applicable for burnishing and for its final removal from the cavity.

In flowing the solder do not let it flow over the marginal edges, as it will prevent an easy adaptation in the operation of burnishing. It is not absolutely necessary to thicken all matrices; the process is required only in those cases where considerable difficulty is experienced in teasing the matrix from the cavity, as it is sometimes found in deep, irregular cavities, but in ones of lesser depth, where an intervening strata of cement is placed, the procedure is not necessary.

Matrices can be accurately withdrawn by the impression method, that is, by using a small portion of compound, softened by dry heat, and inserted on special impression trays (which I shall describe later), then forced in the cavity over the matrix which, after allowing sufficient time to harden, can be removed without affecting in the least possible degree its shape. The matrix is then ready for making the necessary retention attachments.

After the process of swaging the matrix approximately in apposition to the cavity walls, it is ready for the operation of burnishing to all parts of the cavity and cavity margins, and this is accomplished by the use of suitable matrix instruments. The use of matrix instruments devised for burnishing matrices is confined chiefly to porcelain operations, and the method is more adaptable to anterior teeth. As those instruments have their limitations, for gold inlay work, I was led to devise a set of gold inlay matrix burnishers that would be applicable to posterior as well as anterior teeth. These instruments (Fig. 6) vary in their curvatures and burnishing extensions, so that they can be used in any shaped cavity, in any situation in the teeth.

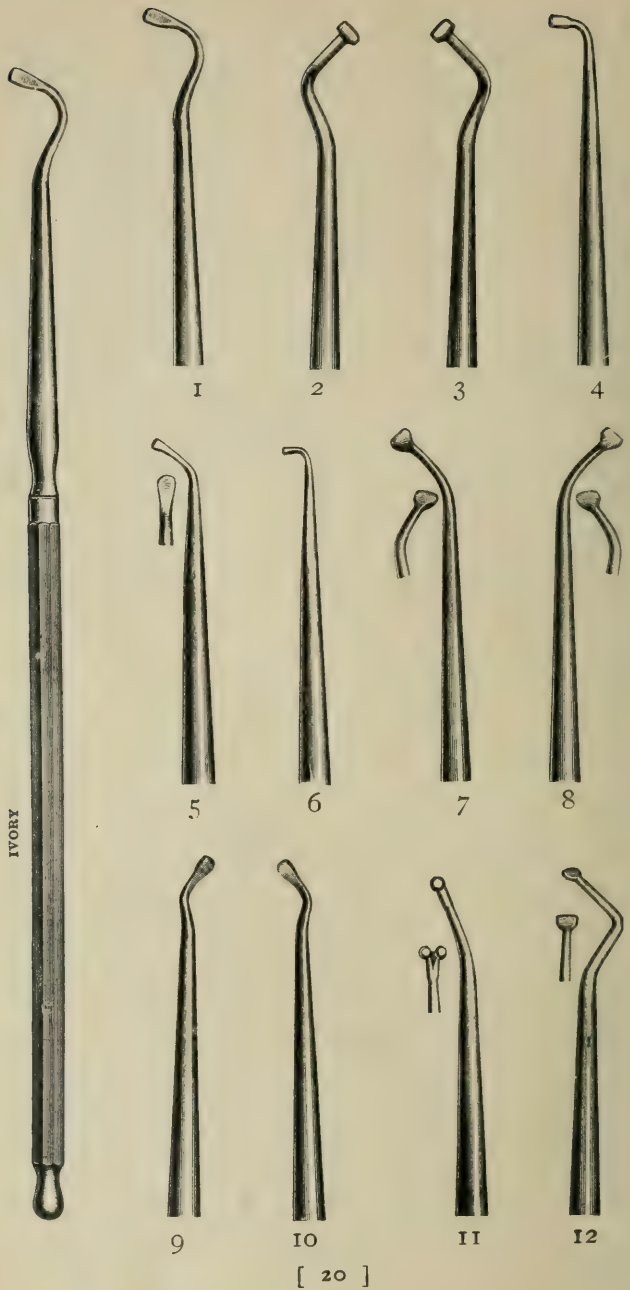
To obtain the best results in burnishing matrices in the cavities the matrix instruments should be so constructed that the greatest possible surface of the matrix will be forced in position at every manipulation. In order to do this, the burnishing surfaces of the matrix instruments should assume more of the flattened form, with fine rounded edges, so as not to tear the matrix in the act of burnishing. To use round ball burnishers, a considerable less surface of the matrix would be forced in position by a similar act.

In commencing the operation of burnishing the matrix in apposition to the cavity walls, better results are obtained by using a *pressing force,* gently applied, as the metal can be forced in position without becoming rigid, for when vigorous burnishing is done the matrix metal becomes very rigid and buckling is apt to occur. By the manipulation of the matrix instruments in a careful manner the matrix can be forced and stretched to all parts of the cavity.

In adapting the matrix to the marginal edges the utmost care should be exercised, as any failure to produce an accurate fit will result in a defective inlay. The matrix should lap over the marginal edges, about two lines, so that a thorough burnishing of the edges of the cavity can be accomplished.

To accomplish the operation of accurately fitting the matrix to the marginal edges, use the small double-balled instrument having on either side a marginal groove which astrides the edge of the cavity, thus acting in a twofold manner in burnishing the matrix slightly over the edge in the cavity and at the same time burnishing that part

Fig. 6.



which overlaps on the external surfaces of the tooth. (Fig. 6, No. 11.) These burnishing instruments may also be used to force pellets of cotton spunk and unvulcanized rubber in the cavity in the operation of swaging. To retain the matrix in place while burnishing, the application of a pledget of cotton or a small portion of soft rubber forced between the teeth is very effective.

As the gingival margins of the cavities are the most remote for manipulating the matrix, and as many times they are not clearly exposed to view, it is very essential that the operator should give extra attention to this detail and see that the matrix metal overlaps the gingival margin and is thoroughly burnished, for any defect in this situation will eventually prove disastrous and the outcome will be the recurrence of decay on the exposed surface of dentin. To thoroughly adapt the matrix to the gingival margin requires the use of a thin flattened burnisher passed between the gum and adjoining part of the matrix overlapping the gingival margin. (Fig. 6, No. 12.)

After finally forcing the matrix in apposition to the cavity walls and edges, by the *pressing* operation, heretofore mentioned, the actual *burnishing* motion can be resorted to, after which the matrix should be ready for withdrawal from the cavity. To withdraw the matrix from the cavity, it should be gently teased therefrom, with a fine pointed instrument, or removed by the application of a small portion of wax inserted on a suitable tray used for that purpose. Some of the inlay matrix instruments can be used to advantage for plastic operations, but they should be reserved for the purpose for which they are intended, as they are then sure to be free from any mercurial deposit.

INDIRECT OR IMPRESSION METHOD OF FORMING THE MATRIX

Many operators prefer in inlay work to construct the matrix by the indirect method, claiming that better results can be obtained by swaging the matrix on a model than by the means of burnishing the matrix directly into the cavity, and that a model should be constructed for swaging in order to obtain the best results. This is certainly true in certain cases, but in the greater number of cases the most approved methods of adapting the matrix to the cavity by means of metal burnishers give better results as a whole in producing a truer relationship between the matrix and the cavity edges.

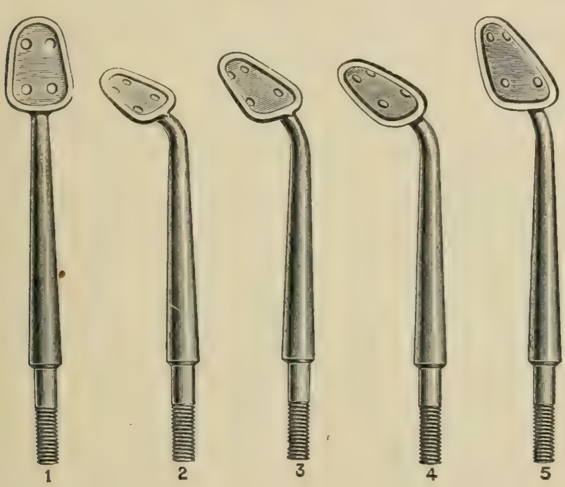
In making a choice of methods, much will depend upon the position of the cavity, for there are many instances where greater space is necessary between the teeth for taking an impression than is required to directly swage the matrix. Still, the operator should be sufficiently familiar with both methods, and should adopt one or the other as particular cases may indicate.

The preparation of the cavity and cavity edges for this method is the same as for the direct, with the one exception, that a positive filling of all undercuts is absolutely necessary, whereas in the direct method the operator need not stretch the matrix to its full extent to fill them. To form the matrix by the indirect method requires the taking of an impression of the cavity, the construction of a model therefrom to form the die, and the final swaging of the matrix thereto.

Taking an Impression of the Cavity.— If the operator considers that better results can be obtained by using a model, an impression of the cavity may be taken in the following way: After the cavity has been thoroughly prepared it should be well dried and the whole cavity and margins lubricated with cocoa-butter or surfaced with talcum powder, treating it in such a way that it will be thoroughly rubbed on the internal surfaces by means of a small piece of spunk or a pellet of cotton, so that the impression material easily detaches on its withdrawal from the cavity. As has been said previously on cavity preparation in proximal cavities, the margins should in no way touch the surface of the adjoining tooth, nor should the margins of the cavity come so near the adjoining tooth as to prevent an easy removal of the matrix, or the insertion of a cavity impression tray and the successful removal of the impression.

For the purpose of taking impressions of various cavities, I have constructed a set of impression trays, consisting of five different forms and three sizes, mounted on cone-socket handles, so as to be adapted to any situation in the teeth and to a cavity of any size (Fig. 7). They are made of thin metal, sufficiently rigid, so that they will not easily bend, and having an edge turned in to allow for a 1-100 of an inch undercut. There are also holes on the trays to give attachment to the impression material, so that it will not become detached from the tray in the act of withdrawing from the cavity. The materials used for taking impressions and the methods of manipulation vary; some operators prefer to take the impression by using quick-setting cement and incorporating it with a sufficient amount of talcum powder, then applying it to the cavity and allowing enough material to extend over the marginal edges.

FIG. 7.



Usually where the indirect means are employed for forming the matrix, the cavity impression trays can easily be adapted, as the cavities are generally formed to allow an easy insertion and removal of them. These cavity trays may be used to good advantage also in crown-and-bridge-work operations.

I prefer taking an impression of a cavity with either Stent's or "Perfection" compound, and applying a small quantity on a tray softened over a Bunsen burner and then inserting it in the cavity (Fig. 8). After giving sufficient time to harden, it is removed, and a perfect reproduction of the shape of the cavity is obtained. Excellent results can also be had by using dental lac and adapting it as in the former way.

After it has been removed from the cavity, a model can be obtained to form the matrix from this impression (Fig. 9). The model can be obtained by using copper amalgam worked over the surface of the impression, by zinc oxyphosphate, or by investing it in plaster After the material selected has thoroughly hardened, the impression wax is removed by immersing in hot water. The matrix is made by adapting the matrix metal over the model thus obtained, and forcing it in place with a block of unvulcanized rubber, or by using a flexible water bag made for the purpose. After this is done the matrix should be thoroughly pressed in place, by suitable inlay matrix burnishers, to all parts of the model.

FIG. 8

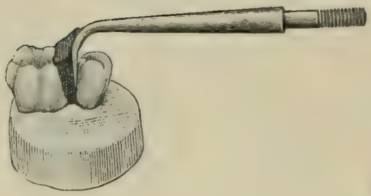
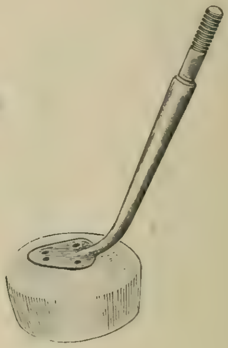
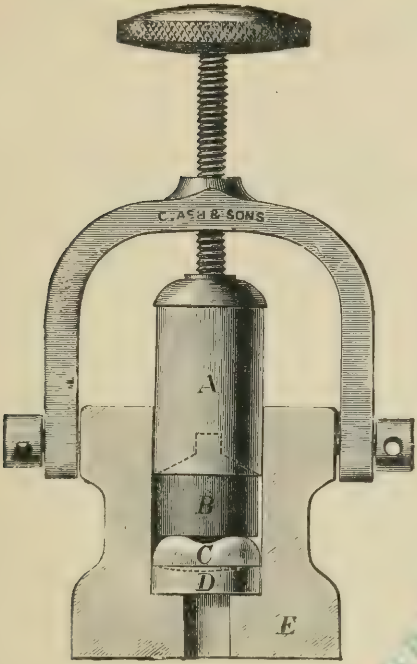


FIG. 9



To more rapidly form a cast from the impression, a small amount of fusible metal may be used. Owing to the very low melting point of this metal it can be poured over the wax without destroying its form. This inlay metal can be obtained from the S. S. White Dental Manufacturing Company in ingots of convenient size. After the model has been obtained in this manner the metal cast or die is then mounted on an Ash's swager (Fig. 10). The thickness of gold used in this case should be .001, as the metal is subjected to considerable force in the process of swaging. Cut the gold somewhat larger than the cast, so as to overlap the marginal edges, burnish approximately, and then use the swaging device.

FIG. 10 (TWO-THIRDS SIZE)



In large cavities involving two or more surfaces the Roach impression cup may be used to advantage, which is made of thin metal of thimble form and can be cut according to the shape and length required. Fig. 11 shows a form of cup and the modeling composition inserted in place. The cup is adjusted to a slit handle (Fig. 12); the cup containing the impression material is warmed, then the cup is telescoped over the tooth in question. After keeping it in this position until the compound becomes thoroughly set, it is then removed, and a perfect reproduction of the cavity is obtained. The handle is then removed, the cup is then placed in the lower part of a small ring in which has been put the necessary amount of moldine. The impression should then be oiled. Place one ring over the other, then pour the metal to obtain the model, after which the matrix is swaged thereon.

FIG. 12

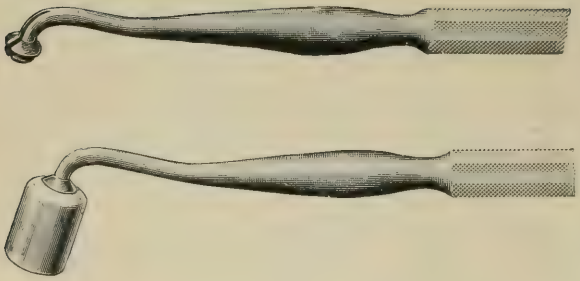
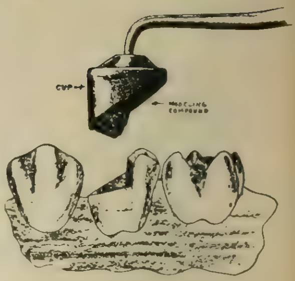


FIG. 11



CONSTRUCTING MODELS

The technique of constructing models varies and will depend, of course, on the material used. In making models of amalgam or cement without the use of pressure, the impression should be inserted in plaster in an upright position, to insure the frail walls of the investment from fracturing, which is shown in Fig. 11.

To secure the impression in this manner will allow a firm base when packing the material to form the model.

If amalgam is used for making models it should be mixed to such plasticity to be easily worked to all parts of the impression. The amalgam should be thoroughly worked into all deep depressions with flat-faced burnishers, the excess of mercury can be removed with spunk or pledgets of cotton. Models made of amalgam make excellent base for constructing the matrix on, as they are definitely accurate and possessing fine outline with considerable edge strength to withstand the swaging process. There is a disadvantage, of course, in using amalgam, and that is the time required for the setting process, which will take from three to six hours before it can be used. After the setting process the compound is removed from the model.

By constructing models of oxyphosphate of zinc there are some advantages, inasmuch as the time required to make them is very much less than by using amalgam, and in case a defective model is obtained another one can be quickly constructed. The cement should be mixed to a putty consistency, the impression coated with talcum or soapstone powder. The cement should be forced in place with burnishers and manipulated in a cone-shaped mass.

The fusible metals that are used for forming models can be melted at such a low temperature that they can be poured over the impression without destroying the finest outline. In making a model, a ring of metal or paper can be used to pour the metal into. This is the most rapid way to form a model, yielding a clear imprint with strong edges to withstand the swaging of the matrix.

The use of Price's "Artificial Stone" is a par excellence material for models, inasmuch as it cannot be broken or affected by ordinary pressure, and also cannot be disintegrated by heat. In constructing a model of this material it should be mixed to a butter consistency and inserted piece by piece into the deeper portions of the impression with a small pointed spatula, so as to force it to all parts and to expel all globules of air; after the model is formed it is then placed over a slow heat to harden the stone model and also allow the removal of the wax impression, after which the model is subjected to a dull-red heat to harden. An additional impression may be taken, in order to have an extra model for finishing and polishing and to show the exact marginal outline of the inlay.

The advantages of using this material are, that the frail walls of the model are produced almost as strong as the tooth tissue, and that the expansion and contraction of the model is so minimized that an accurate fitting inlay is obtained. By this indirect method the operator has a non-vital structure to design and construct the work upon, with free access to all margins, and a model to insert the inlay on for the purpose of finishing and polishing, thereby lessening the amount of work in the mouth.

MEANS OF RETENTION FOR INLAYS

In the construction of gold inlays it is very essential to have good retention, as they are used more frequently in large compound cavities, in molars and bicuspids, where considerable force is applied in the act of attrition, or in anterior teeth, where the enamel walls are too frail to admit the use of cohesive gold.

To obtain the greatest security for inlays, by adhesion of cement to its surfaces, various means have been employed, such as by roughing, grooving, making hollow extensions in the inlay, or by means of counter-sinking, and attachment of pins, posts, loops, tubes, and the extension of the inlay to form dovetail attachments.

In shallow cavities of limited area, where the matrix extends to their full depth, and where it is impossible to make any extended attachment, for the adhesion of the cement, the surface of the inlay is roughened, by a sharp graver, or by making use of dovetail extensions. Another good means of securing attachment, which has been suggested, is to sharpen a straight gold plugger point, then put it in an engine mallet and direct a heavy blow over the surface to give sufficient serrations. This is best accomplished by running the engine at a high speed.

In large compound cavities, involving considerable occluding surface, and also in large contour restorations, more secure retention is required, so as to withstand the force of mastication. In order to accomplish this, various attachments are made on the inlays, such as loops, pins, posts, countersunk and hollow extensions. It may be stated here that pure gold possesses a remarkable property that causes cement to adhere to it in a most tenacious manner.

THE HOLLOW INLAY

In teeth with living pulps, where the cavities are of limited depth, insufficient for any extended anchorage, hollow inlays are most applicable. The hollow extensions made in the inlays will increase the area for the attachment of the cement, as it is self-evident that the greater the cement area the greater will be the anchorage of the inlay.

The several requisites for making hollow inlays are, in the main, the same as for others; namely, a thorough preparation of the cavity and cavity edges, close adaptation of the matrix to the margins of the cavity, sufficient space for the withdrawal of the matrix and subsequent insertion of the inlay, and sufficient allowance for its security in position.

On account of the hollow retention made in the inlay, it is adapted to a greater range of cases and in closer spaces than any other method. Another advantage of this method is, that the depth of the cavity need not be increased for anchorage attachments, the severe operation of cutting away sensitive dentin being thus lessened.

In shallow cavities the hollow depression made in the inlay for the reception of the cement is sufficient for the retention required, and in larger cavities, where considerable stress is applied in mastication, the hollow retention may be increased in proportion.

Should this hollow construction for retention be insufficient in compound shallow cavities involving the occluding surface, the cavity can be so extended to form dovetail attachments, thereby increasing the security of the inlay.

For the details of construction of a hollow inlay, take for example a mesio-occluding cavity in a molar (Fig. 13). After having the cavity and cavity edges thoroughly prepared, and all undercuts filled so as to admit of easy removal of the matrix, the matrix is ready to be swaged and burnished. In deep cavities of this kind a thicker matrix foil should be used, as considerable stretching is needed to force it in apposition to the cavity walls; the thickness of pure gold foil to be used in this case is .002 gauge, as determined by the micrometer. Care should be taken to swage and burnish the matrix, in order to avoid tearing the gold. If the matrix becomes torn in this operation within the cavity, as often occurs, it does not matter, as usually this portion of the matrix is subsequently removed for the reception of the hollow retention.

FIG. 13

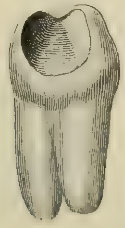
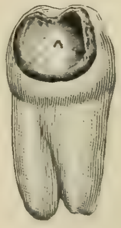


FIG. 14



After a successful removal of the matrix it is then carefully forced on a stick of Stent's or "Perfection" compound, formed about the size of a lead pencil, previously well heated over a Bunsen burner;

the concave or cavity side of the matrix should be gently pressed in the softened portion until it reaches the edges of the matrix overlapping the cavity margins. Fig. 14 shows the matrix swaged in the cavity.

After the compound has become thoroughly hardened, take a good size drill, cut away the matrix according to the size of the hollow required and also extend it beyond the matrix and beneath the edges of the opening as much as the depth of the cavity will allow (Fig. 15). In doing this, care should be taken not to penetrate too close to the marginal edges. The next procedure is to invest the matrix in plaster. Using plaster alone, without the sand mixture, will give equally as good results, as it is easily detached after the soldering process, whereas in using plaster and sand as an investment the particles of sand become fused and adhere to the surface of the inlay. Be sure to run investment well into the hollow retention space, so as to avoid air bubbles. The amount of investment to be used to retain the matrix should be sufficient to make the heating process easy, as using a large quantity will make the soldering and casting of the inlay more difficult.

FIG. 15

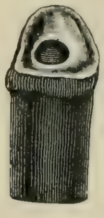
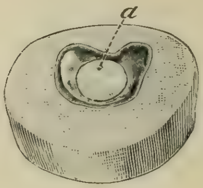


FIG. 16

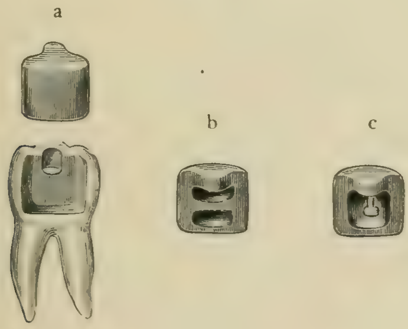


After allowing the investment to become thoroughly set, it is immersed in boiling water, the compound is not to be withdrawn until it is very soft. This is very important, as attempting to draw it forcibly may detach the matrix.

Fig. 16 shows the matrix invested, and the plaster extension which will form the hollow retention, as is indicated by (*a*). If this core of investment extend too much towards the marginal edges or too high to prevent enough contouring, it should be cut down, or, if not sufficient, it may be built higher to increase the size of the hollow retention.

The inlay is now ready for the soldering process; 22-k. gold solder is used for the casting. In order to fill over the core of plaster use small pieces of solder between the core and marginal edges. After this has partly flowed in globules add more pieces until it flows over more surface; then apply larger pieces over the core, so they will join in places, then add more until the desired amount is required; then apply the heat sufficiently so that the whole mass will flow over the whole surface of the inlay. This operation is easily accomplished with the mouth blowpipe, by having the investment placed on a piece of charcoal having a channel cut on its surface to allow the flame to pass beneath, so that the investment will become well heated in the beginning of the process. After the solder has flowed over the entire surface it will have a nice glazed appearance. After the removal of the core, grinding the inlay down to its margins and polishing, the inlay is complete and ready to be finally inserted in the tooth. Fig. 17 (*a*) shows the hollow inlay ready to be cemented in the cavity.

FIG. 17



Another method to form the core is to directly invest the core in the inside or cavity of the matrix, building it up according to the depth of the hollow required. The core is made by the mixture of soapstone and a small quantity of plaster of paris with alcohol. To facilitate an easier flow of solder, the core is first covered with moss-fiber gold and 22-k. solder is placed thereon and the solder then melted. It is sometimes advisable, in compound cavities, and especially in an occluding cavity where considerable force is applied, to make two hollow retention spaces (Fig. 17, *b*). This will better equalize the attachments for the security of the inlay. If the space on the occluding cavity will not allow for two hollow retentions, for one a pin attachment can be substituted, as shown in Fig. 17 (*c*).

Another way of constructing a hollow gold inlay is as follows: After taking an impression of the cavity, a model is obtained therefrom, the matrix is swaged over the surface so as to extend a few lines over the margins. The gauge gold used for the matrix will, of course, be determined by the depth of the cavity and the amount of stretching required to force it to all parts of the model. After the matrix is swaged, the center is removed by carving an orifice according to the size of the hollow required.

After having this done the matrix is placed in the cavity in the mouth. A small piece of modeling composition is placed in the matrix, the patient is allowed to bite into it; a celluloid strip is used to prevent the composition from spreading under the bite. A very thin piece of lead foil is now placed over the occluding surface of the modeling material to allow for the thickness of the piece of gold which is to form the outside of the inlay, enough only to merely cover the occlusal aspect. Remove the matrix, together with the composition, from the mouth and place on the model. The composition is trimmed to margins of the cavity, then it should be tried in the mouth to see if it is all right. Now it is removed from the mouth and then cooled in water and then place on the model. Swage another piece of gold foil, about No. 36 gauge, over the modeling composition while it is still in the matrix. The gold thus swaged should be trimmed and burnished to all parts, after which it is swaged again.

The matrix and the contour piece of gold are separated, the modeling composition removed, the surface of the matrix is covered with a thin layer of whiting to prevent the solder from flowing on to the surface to prevent a defective fit in the inlay. The two pieces are fitted together and soldered with 22-k. solder. Through the hole made in the matrix a lower grade solder can be inserted, and the cavity filled according as the hollow retention required, enough to give sufficient strength to resist the force of mastication.

In conclusion, I may state that the wide range of use of this system allows of its adaptation to almost any cavity, either in the posterior or anterior teeth.

A METHOD OF COUNTERSINKING WITH PIN ATTACHMENTS USED IN MOLARS AND BICUSPIDS

To fully warrant the successful application of inlays in any situation in the teeth two factors are essential, namely, an allowance made for good retention and also the use of the very best adhesive cement. The modus operandi for preparing the cavity edges in the employment of this method of constructing inlays is the same as of any others.

After this operation has been completed, prepare the cavity by filling in any undercuts that may exist beneath the edges of the cavity and the application of a thin layer of cement to fill in any unnecessary depression at its base. The cavity is then ready for the swaging of the matrix. Pure gold may be used. In deep cavities in molars and bicuspids it is advisable to use somewhat thicker matrix material, as considerable stretching will be necessary before it is forced to all parts of the cavity. If it should tear, it can be filled with a piece of pure gold foil subsequently, or in that situation allow for the countersunk. For purposes of description a mesio-occluding cavity in an upper molar may be taken. (Fig. 18.)

FIG. 18

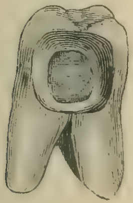


FIG. 19

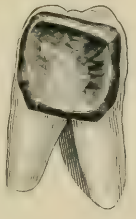
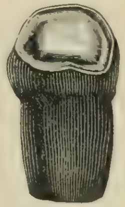


FIG. 20



After the matrix has been accurately formed and burnished in position (Fig. 19) it is ready to be withdrawn from the cavity. To do this it may be gently teased from the cavity, so as not to affect to the least possible degree the shape of the matrix, it is then forced very carefully on a small stick of compound, which has been heated over a Bunsen burner. (Fig. 20.) The wax stick which I have suggested for inlay work can be had from the Detroit Dental Mfg. Co. After allowing time to harden or cool, select the largest drill or bur, then penetrate somewhat beyond the area of retention required when it is ready for the pin attachment. (Fig. 21.) Select a suitable length pin, force the point at the base of the countersunk into the compound beyond, so as to hold it in position, then it is inverted in the investment of plaster and sand, or plaster will do as well. Carefully force the investment into the countersunk and around the pin and then finally up to the edge of the matrix.

The extent to which the pin may protrude beyond the orifice of the countersunk may be determined by the amount of filling-in material at the base of the cavity, as this substance is removed before the final insertion of the filling, thereby allowing greater anchorage.

FIG. 21

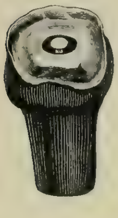


FIG. 22

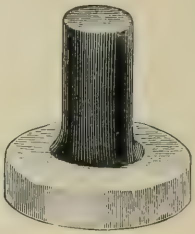
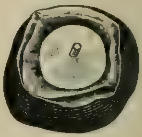


FIG. 23



After the investment becomes sufficiently set it is placed in warm water, so as to soften the compound from the matrix. (Fig. 22.) This will expose the concavity of the matrix, showing the protrusion of the pin and surrounding it an elevation of investment which was previously forced into the countersunk. (Fig. 23.)

It is now ready for forming the contour. Select a piece of pure gold or 22-k. plate, somewhat larger than the surface of the matrix contour, sufficiently so as the case requires, it is then carefully placed in position and forced accurately to the edge of the cavity of the invested matrix, then it is waxed in place.

Place over the contour surface a thin layer of investment, and after it carefully dries remove the wax by means of hot water, after which it is ready for the filling-in process; 18, 20, or 22-k. solder is used, as the case requires. This operation is accomplished by the use of the mouth blowpipe. By this method, if it is considered advisable, more than one countersunk may be used and the same procedure employed for its completion.

Another method used to form the pin attachment is as follows: After the usual method of forming the matrix, tease it from the cavity, and directly invert it in the plaster investment. After giving it sufficient time to harden select the bur or burs, such as were used in the former case, drill at the base of the matrix and somewhat into the investment.

This will form a receptacle for the pin attachment. Then mix a small portion of plaster or plaster and sand, place the pin head downward and in an upright position; then form the investment around the pin and sufficiently high so as to give the greatest possible retension space.

If a large surface of investment is exposed, take a thin piece of pure gold, such as was used for the matrix, punch a hole, cut the shape required, then pass it by the pin and over the surface, this will allow greater ease for the flow of solder. After this has been done, the usual method of filling-in and contouring is employed.

In small cavities, where the area of retention is limited, cement may be used to form the hollow retention space, as when soldering the gold will easily flow over its surface.

Instead of making the retention in the former way described it may be varied to suit the operator. By the first method employed the pins were inserted directly into the compound. To more accurately perform this method of countersinking a small platinum cap is made, the size of the cavity drilled through the matrix, and in the center of the cap a pin is placed and protrudes from it, as the depth of the cavity will allow. This small cap may be made by stamping from a thin piece of platinum soldered to the small tube with pure gold, as in doing so there is less danger of melting the countersunk in the act of soldering. The exposed surface of the cap should have a rack edge, as seen in Fig. 24, a and b. This is affixed in position by waxing, then the matrix and attachments are invested in batter, after which the usual way of completing the inlay is followed out. Still another way is to form the contour first in the following manner: Form the matrix in the usual way, removing it gently from the cavity, then place on a heated end of a stick of compound, convex or cavity side carefully imbedded up to the edges of the matrix, when given sufficient time to cool, take the usual sized bur heretofore used in the same class of cases, drill barely through the matrix into the compound. After this is done select a small piece of gold, contour to place and wax so as to hold it in position, then burnish it around the cavity edges. It may be well to besmear some thinly mixed cement around the overlapping edges of the contour and matrix, as so doing will prevent movement of the matrix after subsequent removal of the compound. Then cut a piece of pure gold for the occluding surface, it also is then waxed in place. The whole built surface is invested, and after giving sufficient time to harden the compound is removed by softening in hot water; in doing this care should be taken not to detach the matrix.

FIG. 24

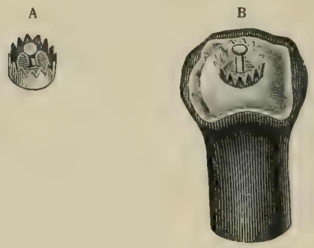
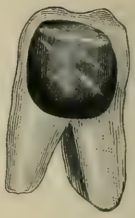


FIG. 25



So far constructed it is a hollow inlay, already with the contour formed, but lacking the filling-in process; before doing the soldering penetrate a pin in an upright position through the orifice made in the matrix into the contour beyond. The length which the pin should extend beyond the opening may be determined by how far the matrix is forced to the base of the cavity and also by the amount of intervening material used at the base of the cavity. Complete the inlay by partly filling the cavity with small pieces of solder, passed through the opening and beneath the matrix. If the matrix is made of platinum there is no risk of melting it in the act of soldering, and in heating the mouth blowpipe should be used. Owing to the very high grade of metal used, borax should be applied in small quantities and in the powdered form.

After allowing a short time to cool, break it from the investment, pickle in acid, trim approximately, then it is ready for cementing in the cavity. After giving time for the cement to set, the inlay is finished in the usual way. Fig. 25 shows the completed inlay in position.

THE SHELL INLAY

In vital teeth where the decay has extended to considerable depth into the dentin, and also in cavities involving the pulp chamber, the shell inlay can be used, as it will admit of greater anchorage for the security of the inlay, by the extension of various attachments, such as pins, posts, tubes, and loops, which are inserted on the inner side of the inlay, thus giving a greater hold for the cement than any other method.

FIG. 26

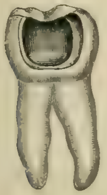


FIG. 27

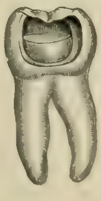
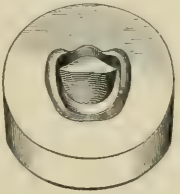


FIG. 28



In describing the construction of a shell inlay, I shall take a large cavity involving the mesio-occluding surface of a molar. Taking for granted that the cavity and cavity edges have been thoroughly prepared as in Fig. 26, make a cement core for the adaptation of the matrix. For this purpose a quick-setting cement is preferred, which should be mixed to a fairly stiff consistency, so that it will not adhere too firmly to the walls of the cavity, as all the cement is removed before the final insertion of the inlay.

By applying the cement at the base of the cavity, filling up the latter nearly to the margins and across the entire floor, a fairly well constructed core can be obtained. In addition, with carving instru-

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ments the core can be so cut that a ledge will be made of a few lines in width between the core and the margins of the cavity. Fig. 27 shows the core in position ready for the swaging of the matrix.

The use of an intervening substance of this kind will prevent the unnecessary extension of the matrix to the base of the cavity, and at the same time minimize the amount of gold to be used for the contouring.

As the insertion of the core at the base of the cavity will prevent the stretching of the matrix to any great extent, consequently a thinner foil may be used, and the matrix can be easily burnished directly in the cavity, as the labor of manipulation is much lessened by having the intervening stratum of cement beneath, or the matrix can be obtained by the indirect method, that is, by taking an impression of the cavity with compound or lac, inserting it on a suitable tray, and then investing it in order to obtain a die.

Apply upon the die thus obtained a piece of gold foil of sufficient size, and adjust it in position by means of a piece of rubber swaged directly over the matrix, or the cast can be inserted in a swaging device used for this purpose, then finally burnished to all parts of the cast. (Fig. 28.)

FIG. 29

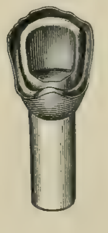


FIG. 30

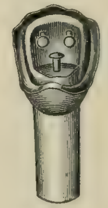


FIG. 31

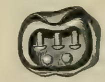
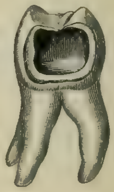


FIG. 32



It is advisable in large compound cavities in molars, involving the buccal and morsal surfaces, to make the matrix in two pieces. After they have been approximately swaged, they should be waxed together, then carefully removed and a very small amount of 22-k. solder used to unite them in one piece. This will prevent the buckling of the gold in the act of swaging and burnishing and facilitate a correct adaptation to the cavity. When satisfied that the matrix has been correctly adapted, remove it gently by teasing it from the cavity with a fine-pointed instrument.

The next procedure is to take a stick of compound, and after softening one end over a Bunsen burner, press the matrix into it, forcing the external surface into the wax up to the marginal edges of the matrix. (Fig. 29.) Care must be observed in doing this, as any undue pressure may change the form of the matrix. The latter being imbedded in the wax, drill holes for the insertion of the pins. The pins should have well-formed heads (Fig. 30) and the extent which the pins should protrude from the matrix will be determined by the core and depth of the cavity. Figs. 31 and 32 show a completed inlay, a mesio-occluding cavity in a molar.

In teeth with living pulps, where the cavities are of limited depth (Fig. 33), insufficient for any extended anchorage, countersunk holes should be used. (Fig. 34.)

FIG. 33

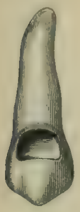


FIG. 34

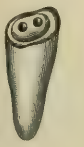


FIG. 35

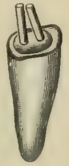


FIG. 36

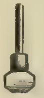


FIG. 37

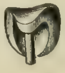
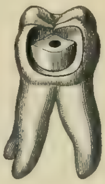


FIG. 38



The countersunk holes are prepared by inserting graphite points into the holes thus made. (Fig. 35.) They should be made to penetrate beyond the matrix, and after the filling process has been accomplished they are removed, thus leaving holes which, becoming filled with retentive material, will afford sufficient anchorage for the inlay. At this stage, if the operator should find it necessary, the retention can be further increased by using both pins and countersunk depressions, or by using a small tube sufficiently long to obtain a strong anchorage at the base of the cavity, extending it as high as the surface of the core. To secure this in position, solder at the lower end a small plate of metal, as will best suit the extent of the cavity.

This tube attachment (Fig. 36) is cemented permanently in an upright position, so that the wire or post anchorage, which is attached to the matrix, will accurately pass within the already cemented post within the core. The hollow post which is fastened in the tooth should extend slightly beyond the core, so that when the matrix is pressed over it, it will show a slight indentation which will indicate where to penetrate the matrix for the anchorage post, which should fit the hollow tube accurately.

Fig. 37 shows the matrix and post removed from the cavity, as is indicated in Fig. 38.

To make the contour, cut a piece of 22-k. gold plate, roll it fairly thin so that it will be easier to manipulate, then apply it to the vacant side of the inlay, and then wax it in position. Finally insert the matrix in investment material to hold in place the two pieces while the casting process is accomplished. Twenty-two-karat solder should be used for the filling-in process, as using such a high grade of gold will give the inlay, when finished, a decidedly rich appearance. Fig. 39 shows the core removed from the insertion of the inlay. In using borax as a flux do not apply very much at a time, and it should be sprinkled on dry, for if it be used wet it may possibly form an incrustation, which will prevent the solder from flowing to all parts of the matrix, and thus make a defective inlay. To cement the inlay in position use the very best adhesive cement obtainable. After giving the cement sufficient time to set, the inlay is then polished and burnished. Fig. 40 shows the inlay finished in the cavity.

FIG. 39

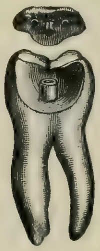
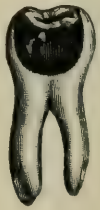


FIG. 40



In constructing inlays for anterior teeth the method which I follow is very similar to those which have been described; namely, the

FIG. 41 SHOWS "CORE" IN POSITION IN THE CAVITY.

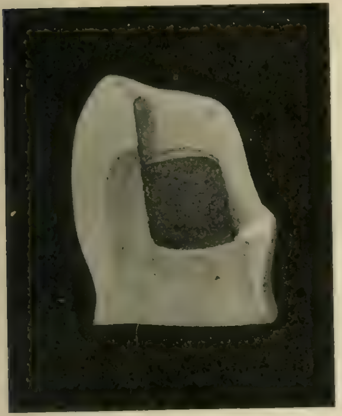


FIG. 42. INLAY RESTORATION IN CAVITY OVER CORE.

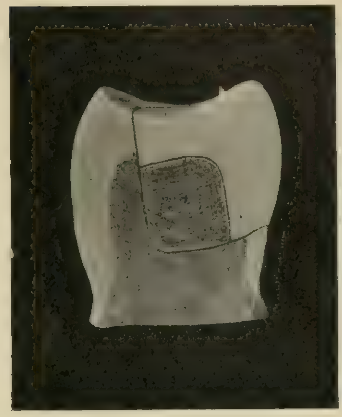


FIG. 43. SHELL INLAY PIN ATTACHMENTS.

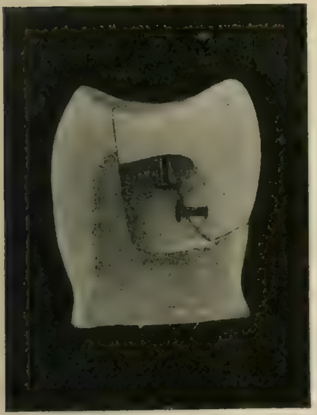
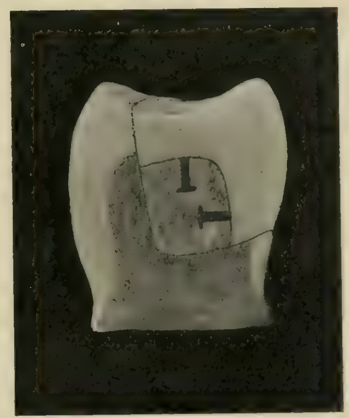


FIG. 44. INLAY CEMENTED INTO THE CAVITY.



application of the core to the cavity, the taking of the impression, the construction of the die or burnishing the matrix directly into the cavity, the making of the various attachments necessary, and the casting process, after which the inlay is cemented in the cavity and finished in a similar manner.

Of course, it is well to avoid the use of gold inlays in these teeth, as the porcelain inlays meet all the requirements; but when porcelain cannot be substituted the gold inlay can be successfully used.

INLAYS FORMED BY THE USE OF SPONGE GOLD

The application of sponge gold for forming inlays and other restorations yields very satisfactory results. It is a means whereby the form of gold can be manipulated into the cavity with sufficient ease in order to obtain an accurate imprint of the cavity to be inlayed. The time required to make inlays by this method is very much shorter, as the technique is very much less than by any other means.

The form of sponge gold known as moss fiber can be obtained from supply houses, and is especially prepared for this purpose.

FIG. 45

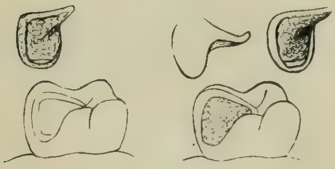
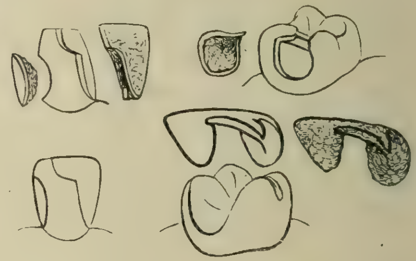


FIG. 46



It is made in mat form, three-eighths of an inch in thickness, which is more suitable for this work than gold prepared in strips.

The preparation of a cavity to receive the metal imprint is the same as adapted by other methods of inlaying, that is, the cavity should be formed so that an easy draw of the gold can be made to prevent destroying the marginal edges on its removal.

In commencing the formation of sponge gold inlays a surplus amount of gold should be torn from the mat so that there will always be an extra amount to fill the cavity and allow burnishing over the marginal edges, and also to give the filling the proper contour. It is not necessary to entirely exclude moisture from the cavity, if a piece is selected to fill it entirely, but if more gold is needed it cannot be applied on a moistened surface.

Figs. 45 and 46 show the sponge gold condensed to the form of the cavity (after CHAS. L. ALEXANDER).

In preparing the gold, it should be manipulated with the fingers to give it the proper shape and size of the cavity to be inlayed. The gold in this form is placed in the cavity and condensed with hand pressure, using broad plastic instruments, so that a large surface will be condensed at once, making it more adaptable to the cavity. The proximal surface of the filling is forced into the cavity with a flat burnisher. Care should be taken to have the gold well burnished against the cavity edges, and also overlapping the cavity margins.

To obtain the correct occlusion of the teeth, the patient may be allowed to close firmly upon the condensed gold, thereby making a perfect contact. The whole surface should be burnished to a smooth appearance, which will consequently give a better finished cast. In removing the gold form from the cavity, care is taken not to affect its shape; it is then invested, leaving only a small portion of the gold exposed on the contour surface.

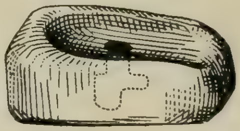
The most suitable investment for this work is what is known as sump, this material possessing the property of not becoming cracked or affected by the application of intense heat. The investment should be mixed to the same consistency as other investments for a similar purpose, a small amount of sump being placed on a piece of paper, then the gold form is immersed into it, leaving an opening for the passage of the solder.

The size opening to leave into the investment will be governed by the size of the cast, but 14 gauge will be sufficient for ordinary cases.

The surface on which the gold solder is melted requires a slight concavity made into it, so as to retain the solder in place during the casting. Fig. 47 shows the prepared case.

In preparing to cast the case it is placed on a soldering gauze frame which is heated from beneath, the blow-pipe flame at the same time applied directly on the 22-k. solder, until the temperature of the molten sponge gold is sufficiently raised to absorb the solder. It is advisable to have an excess of solder in the beginning to do the casting; this can be easily calculated after some practice; if there is not enough to fill the mold, additional solder, together with pieces of sponge gold, can be packed within to readily absorb the solder.

FIG. 47



The solder is cut in convenient size pieces of one-fourth to one-quarter inch. Through the whole fusing process, the gold should be elevated to such a temperature as to get the gold in sufficient molten condition to eliminate all air bubbles. After the casting, the inlay is removed from the investment, the excess of solder is cut off, the inlay being polished ready to be inserted in the tooth.

This method of constructing inlays is not confined to making simple restorations, but it also can be used as other methods in crown and bridge work.

The profession is indebted to Dr. Charles L. Alexander, Charlotte, N. C., for developing the technique of the sponge gold inlay. An interesting article from his pen is adequately described in Vol. XIV, *Dental Brief*.

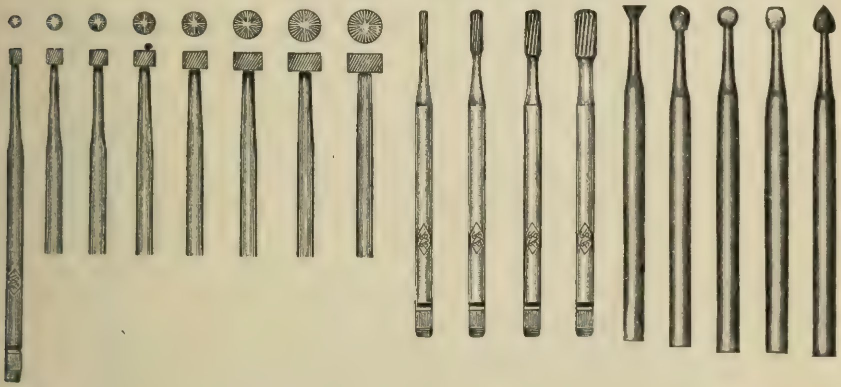
THE PREPARATION OF CAVITIES FOR GOLD INLAYS

The preparation of cavities for gold inlays and methods used for retention differ so materially from other forms of fillings, that the technique of their formation has been the outcome of special consideration, on account of the material used being inserted in a solid mass and the security depending to a great extent on the cavity preparation, so that, when the inlay is inserted in place it will be self-supporting, whereas in cohesive gold fillings the retention depends chiefly on the formation within the cavity.

Some operators adapt the principle of cavity formation for gold inlays as is advocated for cohesive gold by making extension for prevention of caries, but recurrence of decay is not liable to occur, for the fact that the intervention of cement under the fillings protects the tooth tissue from caries.

In commencing the formation of the cavity, cut away freely all overhanging margins of enamel, so as to obtain access into the cavity; this is accomplished by the use of suitable chisels; and the next step is to remove all infected tissue within the cavity, as if for reception of cohesive gold.

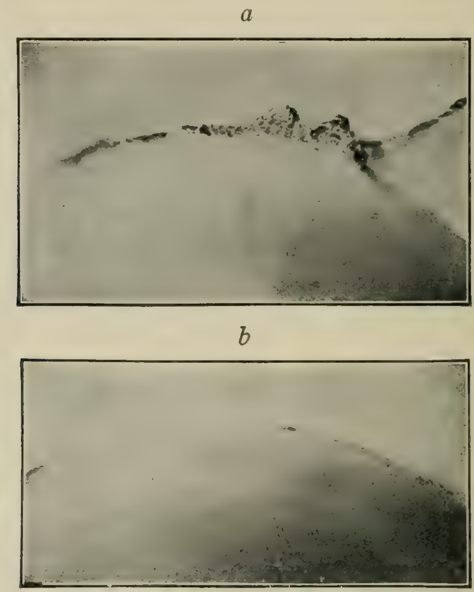
FIG. 48



It has been recommended by some operators in inlay work, not to remove all carious matter within the cavity, claiming that it is much easier to manipulate the wax, or in taking an impression less difficulty is experienced. I prefer to cleanse the cavity of all decay and prepare it in such a manner that it will be ready for the final insertion of the inlay. In this way the operator becomes more familiar with the conditions of the cavity. In deep cavities where it is unnecessary to extend the wax to the full extent, a core of cement or other suitable material may be used, this will prevent the filling from extending to the full depth of the cavity, and thus allow a chance for attachments to the inlay, and also make it much easier to adapt the inlay to the cavity.

The marginal edges of the cavity should be prepared so as to overcome any sharp extensions, as it would be impossible to swage the matrix over such parts without their becoming destroyed, and in case the inlay is made by the wax dispersion method, the pressure of the gold flowing over such sharp extensions in the mold may cause a defective fit of the inlay. The marginal edges of the cavity can be prepared by using fine cavity burs, stone and finishing disks. Fig. 48 illustrates some convenient forms and sizes of burs and stones.

FIG. 49



a

b

The marginal edges of the cavity should be cut straight and beveling avoided. In my earlier experience with the preparation of the marginal edges in using the matrix method, I soon found that beveling the edges was not so practical as it first appeared, for it only made a more complicated border in forming the cavity and at the same time made too thin an edge around the filling to successfully make a definite polished marginal edge. Better results are obtained by having the filling come directly in contact with the tooth tissue without any beveling, that is, the filling should butt against the cavity walls, so that in finishing the filling it will come direct in contact with the cavity marginal edge of the tooth.

The various forms of cavity burs as well as finishing stones are used to prepare the marginal edges. It has been demonstrated by Dr. H. W. Arthur, of Pittsburg, that more perfect results can be obtained by the use of stones, as is clearly seen in Fig. 49, *a* and *b*,— *a* shows a margin of a cavity prepared with a plug finishing burr, *b* a similar cavity prepared with stones. These photographs were reproduced from untouched negatives.

SIMPLE CAVITIES UPON EXPOSED SURFACES OF INCISORS

There are two classes of cavities on exposed surfaces of incisors and cuspids for which the inlaying process of filling is more particularly adapted, namely: first, large cavities that are located at the cervical, and, second, those near the morsal edge.

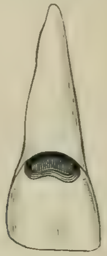
Cavities that exist at the cervical edge, especially those that extend beyond the gum, present many times considerable difficulty when cohesive gold is used for filling, as great difficulty is ofttimes experienced in adjusting the rubber dam and the application of ligatures and other attachments necessary, as absolute dryness of the cavity is very essential in its preparation, as well as for the subsequent operation of filling; but inlaying these cavities with gold precludes the use of these very painful attachments, lessening to a great extent the severity and duration of these operations, and also diminishing the possibility of failure to successfully fill these classes of cavities, thus relieving the operator of considerable anxiety.

Cavities at the cervix usually present no difficulty in their preparation as they are in full view and of a saucer-shaped appearance, and ofttimes consist of a softened condition of the enamel without any visible loss of structure; while in other instances there is a deeper destruction of tooth tissue extending also beyond the gingival margin. Under such conditions it is absolutely necessary to retract the overhanging gum in order to obtain a good view of the cavity and to properly prepare the cervical margin.

This is very well accomplished in the simpler cases by the use of a suitable depressor, but in the more complicated cases it is necessary to excise the gum tissue, or evert the gum by the application of gutta-percha, letting it remain until another sitting. This operation will allow a greater scope for preparing the cavity and the subsequent insertion of the inlay. After the gum has been sufficiently everted to expose to view the whole cavity it is ready for its preparation for the reception of the matrix. To commence the preparation of the cavity, a round bur should first be used, as this form of bur facilitates the removal of the infected tissue and also lessens the painfulness of the operation.

If any irregular extension of the decay should occur, it should be cut away, so as to give the cavity a round or oval form; doing this will allow an easy adaptation of the matrix, for if any sharp angles of the cavity should remain it will be impossible to force the matrix easily to all the parts.

FIG. 50



Cut the floor of the cavity flat, but the marginal edges should be cut perpendicular so as to avoid any undercuts; this is nicely accomplished by using a fissure bur. In saucer-shaped cavities also make abrupt walls. The cervical border of the cavity should be cut of a greater arc of a circle than the opposite edge, which should be cut more of a crescent form. Fig. 50 shows the location of this class of cavities and the cavity correctly prepared. By forming it in this manner the tissue is cut usually where it is defective, and also enables the operator to form the inlay in such a shape that it can be easily inserted in the cavity.

The preparation of the cavity as described will form a saddle formation for the inlay to set, thus allowing a greater security to the filling. The failure to successfully insert fillings in this situation can be traced usually to faulty preparation of the cavity edges.

After the cavity edges have been thoroughly polished it is ready for the swaging of the matrix or taking an impression for the purpose of constructing the inlay in that manner. The thickness of gold foil to be used in these cavities to be inlayed should not exceed .003 of an inch, as any thicker foil in cavities of this size will be very difficult to swage and burnish to the cavity successfully. Cut the matrix gold in a round or oval form, and then approximately swage to the cavity, then it is removed and trimmed a few lines over the marginal edges. Thoroughly anneal the gold before inserting it again in the cavity, then burnish the matrix accurately to all parts of the cavity. It is then ready to be removed from the cavity; this can be done either by gently teasing the matrix from the cavity or withdrawing it by inserting a small piece of wax on an impression tray and removing it in this way.

Owing to the limited depth of this class of cavities the retention is also limited, usually to two methods of security, namely, by roughening the cavity surface of the inlay or by using a hollow extension in the inlay. In the former way the inlay is directly cast, in the latter a retention is made in the matrix.

If the matrix is teased from the cavity, it is inserted on a stick of impression wax heated over a Bunsen burner. The retention for the inlay is then made by drilling holes through the matrix into the wax beyond, according as the depth of the cavity will allow. Plaster is then run over the surface and in the hollow retentions, or previous to doing this graphite points can be inserted in the holes. The wax is removed by immersing in hot water. This will expose the invested matrix and the cores protruding in the cavity. On account of these cavities being on visible surfaces 22-k. solder should be used; this when finished will give a decidedly rich appearance.

Where there is no hollow retention made the matrix need not necessarily be invested, as smearing the under surface with whitening or a thinly mixed coat of plaster will be all that is necessary to prevent the matrix from melting in the act of casting. After the matrix is removed from the investment it is pickled in the acid bath and then trimmed and finished, so as to lessen this operation after it is finally inserted in the cavity. Cement the inlay in place by applying a small amount on the inlay and in the cavity. Burnish the edges thoroughly before the inlay sets, after which it is polished. Sometimes it is advisable to give the inlay a dull finish, and this can be done by using finely powdered pumice over its surface.

Cavities near the morsal edge are sometimes found large enough to inlay with gold, but usually cavities in this situation are the result of defective development of the enamel, resulting in pits or grooves, and are better filled with cohesive gold.

In cuspid teeth the cavities to be inlayed are invariably located on the cervical border, and are frequently deeper seated than in other incisor teeth, as these teeth are considerably thicker, and the decay ofttimes extends beyond the gum margin.

Cavities on the cervical edge of incisors offer no difficulty when the inlaying process is adopted.

THE RESTORATION OF ABRADED SURFACES AND THE BROKEN ANGLES OF INCISORS

The restoration of abraded surfaces, and the broken angles of incisors and cuspids, presents most formidable difficulties, on account, many times, of the lack of security of the filling and of the limited area of retention; the fillings are subjected to considerable stress also, and more especially if there is direct occlusion.

This is particularly true when cohesive gold is used, but by the inlaying process those defects are more easily remedied by virtue of the greater security of the filling and also by reason of the inlay being cast in one solid piece, it offers a greater resisting force in the act of mastication.

The abraded surfaces of incisors and cuspids that require restoring are generally worn away by attrition, involving the morsal portion of the enamel and also considerable loss of dentinal tissue, thus causing the teeth to become very sensitive by reason of the exposure of the fine nerve filaments. This condition of the tooth tissue is effectively overcome by the intervention of the cement used to retain the inlay in place, it acting also as a non-conductor, and thus preventing thermal shock.

When, because of loss of tooth tissue in this situation, either by mechanical or chemical action, it is found necessary to "open the bite," the lengthening of the teeth by inlaying can be used to a satisfactory advantage.

Usually in this condition the tooth structure presents a level or pitted appearance and thus very little cavity formation existing, and the retention depending upon artificial cavity construction so prepared to have strong retentive form, as fillings of this class are subjected to considerable stress.

FIG. 51

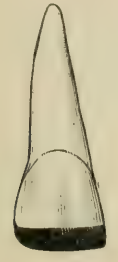


FIG. 52

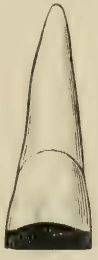
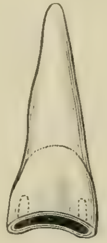


FIG. 53



The preparation of the abraded surface of incisor for the adaptation of the inlay extension is made according as the case presents, as, for instance, in a leveled incisal edge, as in Fig. 51, the surface requires very little preparation, but if any sharp or thin enamel is found it should be cut away, so as to prevent any subsequent fracture and also to prevent any tearing of the matrix in the act of swaging. Sometimes it is advisable to construct the incisal surface in a crescentic form, as in Fig. 52, as it increases the security of the inlay against any lateral pressure, and a slight curved outline has a more pleasing effect.

Cavities prepared for the reception of the inlays are usually countersunk in the dentinal tissue of sufficient depth to allow for some retention for the inlay, according as the tooth tissue will allow, so that it will in no way affect the vitality of the pulp, and the retention can be increased by the insertion of pins attached to the surface of the inlay and countersunk holes made in the artificial prepared cavities, one near each extremity, as shown in Fig. 53.

Usually the abraded surfaces of incisors and cuspid teeth have considerable morsal surface to allow for an artificial cavity formation, but where this is not admissible the retention of the inlay will solely depend on pin attachments.

The morsal surface of the tooth is prepared by cutting away any of the sharp enamel edges and polishing the edges of the tooth with a sandpaper disk, so that it will prevent tearing of the matrix in swaging.

In preparing the artificial cavity for the reception of the inlay, cut the tooth structure by means of a fissure bur of such a depth as the extent of the cavity required.

The floor of the cavity should be cut on a level plane, and the side walls should be made perpendicular, without any undercuts, and after the cavity has been completed in this manner the marginal edges are then polished.

To make the retention for the inlay, holes are countersunk near the extreme ends and base of the cavity, so as to allow for the insertion of pins, used for the security of the inlay. The thickness of pure gold to be used in these cases should not be more than .002 of an inch in thickness, as in this situation a thinner foil is more adaptable.

After the matrix is burnished to all parts of the cavity and trimmed so as to extend over the cavity edges, the pins are forced through the matrix and in the countersunk holes beyond. To successfully remove the matrix and pin attachments from the cavity is best accomplished by inserting a small amount of impression wax on an impression tray, warmed by dry heat, and then forcing it over the matrix and pin attachments; after allowing the wax to set it is withdrawn without distorting or affecting its shape; it is then invested in plaster, and after allowing it to set thoroughly the wax is removed by immersing it in hot water. The extent of the incisal restoration will depend upon the abraded condition and the distance necessary to open the bite to obtain correct occlusion.

When a number of teeth are abraded it may be necessary to form an articulation, and this can be obtained by making a cast of the opposing teeth.

In order to form the contour and depth of the inlay, cut a piece of gold a trifle thicker than that which is used for the matrix, and cut according to the width and depth of the abraded surface to be restored; this is formed around the outer edge of the matrix and held in place by wax poured on the inner surface. Place around this contour surface of gold some investment to hold it intact, and after the wax is removed, after the hardening process, the inlay is cast with 22-k. solder and contoured according to the articulation required.

After the heating process is completed, it is removed from the investment and finished approximately; it is ready then to be placed in position. Apply cement into the countersunk holes in the cavity and also upon the inlay, and then force the inlay gently in place so as not to expel too much cement. After giving time for the cement to set the usual manner of finishing and polishing the inlay is carried out.

In cuspid teeth the same methods are followed for inlay as in the other incisor teeth, including the preparation of the cavity for the reception of the inlay, the construction and final insertion.

Owing usually to a large area of abrasion these teeth offer a better chance for retention than the other incisors, and as a consequence extra pin attachments may be used if necessary.

FIG. 54

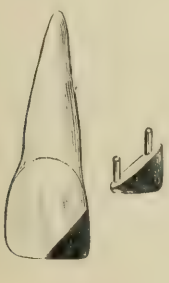
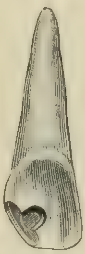


FIG. 55



The broken angles of incisor are also very difficult to restore, on account of the limited anchorage, especially when cohesive gold is used, but these defects are easier restored by the inlaying process, as greater security can be had by attachments to retain the inlay to the cavity.

In preparing the incisal edge, cut away any irregular tooth tissue so as to leave a flattened surface (Fig. 54), and in preparing the marginal edges care should be observed not to have any sharp outlines of enamel, so that the matrix will not become cut in the operation of swaging and burnishing.

In order to obtain greater surface for the reception of the inlay, an extension can be made in the lingual surface (Fig. 55); this will allow for greater retention of the inlay, at the same time aid in securing more attachment and lessening the possibility of the inlay becoming loosened by any lateral pressure.

The preparation of the countersunk holes in the enamel for pin attachments is the same as for those used for abraded surfaces.

The thickness of gold foil to be used for the matrix is the same as for the abraded surface, as very little stretching of the metal is required in these cases.

After the matrix has been burnished into the countersunk holes or groove made in the enamel tissue to form a cavity, the pins are inserted through the matrix into the countersunk holes which have been drilled towards the extreme end of the cavity, and the whole removed in the usual manner, the investment is then made, and the contouring and restoration of the inlay carried out.

PROXIMAL CAVITIES OF INCISOR TEETH INVOLVING THE INCISAL ANGLE

In anterior teeth where there is considerable loss of tooth tissue the gold inlaying process of filling teeth may be used very successfully, and permanent results obtained. As operators of cohesive gold have observed, that there are certain points around the fillings where decay occurs, and this is very frequently noticed in such anatomical situations of the proximal surfaces of the incisors, where an area of enamel is not cleansed by the natural process, and in such situations as the gingivo-labial and gingivo-lingual margins, for as these regions are not kept clean by the frictional movement of the tongue, lips, and by mastication, recurrence is more liable to occur. Another cause of failure in the use of cohesive gold fillings is, that the lingual surfaces of these cavity margins are left very thin, this causing fracture to occur in the act of mastication, thereby leaving a space for the lodgment of debris, thus producing decay and the final destruction of the filling.

Then, too, the difficult situations in which the foil must be manipulated, many times causes a defect in the filling which allows a chance for the ingress of moisture, but by the inlaying process, these defects are easily remedied, as the filling is inserted in one solid mass, and the intervention of cement between the filling and tooth tissue secures any frail enamel edges and also seals the cavity from moisture, thus preventing the possibility of failure.

Cavity Preparation.— The preparation of these cavities for gold inlays differs from cohesive gold, inasmuch as no undercuts are admissible, so that the matrix may be withdrawn easily from the cavity, or in event of a wax impression being taken no difficulty will be experienced on its removal, nor any difficulty in the final insertion of the inlay in the cavity.

Owing to the different means adopted for security when inlayed fillings, and when cohesive gold is used, a difference in the preparation of the cavity as well as the cavity edges is required, for in cavities in this situation, the retention of the inlay may not be limited to cavity formation only, but will depend also for security on attachments, or depressions made in the inlay. The marginal edges of these cavities should show a symmetrical outline, and straight lines should not terminate too abruptly in short curvatures; by the use of graceful curves a more æsthetic appearance is given to the finished filling. In the formation of the marginal edges of the cavity for gold inlays it should be clearly understood that no definite angles are permissible. In this respect, definite angles are avoided which are used to a good advantage in cohesive gold operations. Even though the line may be very short, it should, nevertheless, have a definite curve.

Technique.— In commencing the operation of preparing the cavity, cut away all frail enamel margins with sharp, well-formed chisels, so as to obtain easy access into the cavity, which should be prepared in this respect as though it was to receive a cohesive gold filling, so that there may be a thorough removal of all infected tissue, and that the base of the cavity shall be so leveled as to give a firm seat to the inlay. When the carious tissue is removed the cavity walls should then be prepared, the labial surface should be cut straight or nearly perpendicular to the axial line (Fig. 56), but for æsthetic reasons do not sacrifice any more enamel than is absolutely necessary; the thin enamel surfaces in this situation will likewise be protected by the intervention of cement. The gingivo-labial portion should be cut in a definite curved outline as shown in Fig. 56; by cutting the labial surface in this manner it will give a direct passage for the insertion of the inlay and also form a firm seat for the inlay, then the gingival surface should be cut flat, the gingivo-lingual angle of the cavity should assume a less curved outline, according as the formation of the tooth structure will allow. The lingual surface or border of the cavity should be cut in a curved form (Fig. 57), so as to allow, on the insertion of the inlay the contour portion a chance for a passage into the cavity.

FIG. 56

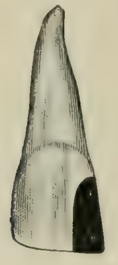
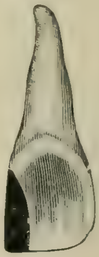


FIG. 57



The preparation of this marginal surface will depend, of course, upon the proximal space existing. The force of stress against these cavities by the lower teeth is generally obliquely upward and in the direction of the labial wall, so that there should be left an adequate amount of enamel wall on the labial surface to overcome this stress to give the greatest security to the filling.

In those teeth where the incisal edge is very thin and hardly sufficient to withstand the occluding stress, the labial wall should be shortened so as to form a step, which will also give a greater security to the inlay. The preparation of this step, mesio-distally, will be governed according as the case presents. The base of the step should be cut perfectly flat, and the extent of its incision will be determined by the frailty of the enamel and the distance from the pulpal region. The incisal termination of the step should be made almost parallel with the long axis of the tooth, and, consequently, at right angles with the pulpal edge. Fig. 58 shows this step formation. By forming a step to the inlay, destruction of the enamel edge from occlusal stress will be prevented. In some cases, where it is necessary to secure the filling against lateral force, an extension can be made pulpally, which is adequately shown in Fig. 59. The extension can be made according as the case will allow, and should be cut so as to allow an easy draw to the matrix or wax from the cavity.

FIG. 58

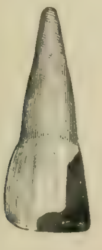
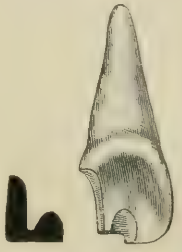


FIG. 59



The whole marginal edge of the cavity should be cut straight and beveling should be avoided. The edges of the cavity should be finished with fine stones and polishing disks.

Where two proximal cavities require inlaying, the larger one should be inserted first, before the final insertion of the other, and also where one incisal edge remains the inlay should be inserted in this cavity first.

The means used for retention other than cavity formation will depend also on the amount of security the inlay has within the cavity, for in vital teeth, where the cavity is of limited depth, the inlay will rest upon the base of the cavity, and the retention can be made by roughing, grooving, or making hollow depressions in the inlay. In this class of cavities the thickness of foil to be used should not exceed .002 of an inch. After it is thoroughly formed to the cavity it is removed and then inserted carefully on a stick of impression wax heated over a Bunsen burner, then the hollow retention is made by drilling holes through the matrix into the investment beyond, and after the casting process is done the investment is removed from the depressions, which will form a security to the inlay.

In devitalized teeth, where the cavity is of a deeper formation, retentions can be made by pin attachments as well. At the base of the cavity a core of cement should be formed so as to prevent the matrix from being forced to the extreme base of the cavity; this will allow, after the removal of the core, a reception for the pin attachments. The pin attachments are made by inserting them in the matrix and allowing them to protrude from the inlay as much as the cavity and also the amount of proximal space existing will allow, and the inlay still be easily inserted in the cavity.

In some instances, where access is obtained in the root canal, a post extension can be used to good advantage for security to the inlay. The means of retention to be used in this class of cavities will be determined according as the case presents. In anterior teeth it is well to avoid the use of the gold inlay, as the porcelain inlay meets the requirements, but when it cannot be substituted, the gold inlay can be successfully used. It is not intended that the gold inlay should replace the cohesive gold filling, but rather that it should supplement it.

PROXIMAL-OCCLUSAL CAVITIES IN BICUSPIDS AND MOLARS

The value of the inlay process of filling cavities in bicuspids and molars as a means of preserving tooth-structure cannot be overestimated. The permanent results obtained by this method are excelled by those of no other, for the attempt at restoring large compound cavities in these teeth by means of cohesive gold or its combinations, where a large area of enamel has been destroyed, thus exposing a large surface of dentin — often likewise badly broken down — many times result in failure, owing to the difficulty of adapting the filling material in the inaccessible portions of the cavity, thus favoring the ingress of moisture and the ultimate recurrence of decay.

By inlaying these cavities with gold, the use of the rubber dam, a very objectionable though indispensable operative accessory in the construction of cohesive gold fillings, may be dispensed with. In large cavities of this class the use of the clamp matrix attachments is also unnecessary, an additional argument in favor of the inlay, for they are not only difficult appliances to insert, but, in addition, are the source of considerable anxiety to the operator, on account of the uncertainty of their remaining in one position throughout the operation. Owing to the anatomical characteristics of the bicuspids and molars, they allow a greater range for the retention of the inlay than do any other teeth, on account of the greater strength of their enamel walls and also because they admit of greater extensions being made on the enamel surface, as well as in the cavity. The restoration of these large compound cavities in the bicuspids and molars by means of the inlaying process of filling diminishes to a considerable extent the severe physical strain on the patient and operator induced by the insertion of cohesive gold foil.

Cavity Preparation.— The technique in the preparation of cavities in molars and bicuspids is very similar. The cavity should be prepared in the usual way, as if for the insertion of a cohesive gold filling, except that no undercuts should be allowed, so that a wax impression can be easily taken, or in the event of a matrix being used it can be easily removed without becoming distorted.

Cut the enamel walls freely away bucco-lingually, so as to give easy access into the cavity, a very essential point when using the direct or indirect methods. For this reason it is not necessary to obtain separation by wedging, as such cavities in these teeth admit of a greater extension in the preparation of the cavity than any other teeth to be inlayed. All frail enamel walls should be removed. The enamel wall must, at any rate, be strong enough to resist fracture in occlusal stress. The marginal edges of the buccal and lingual walls of these cavities should be either parallel or slightly divergent towards the occlusal. The marginal edges should be cut straight and beveling be avoided. The enamel walls should not terminate too abruptly in short curvatures, for it is impossible to obtain of them an accurate impression.

The means used for the security of inlays in these teeth will, of course, depend upon the extent and depth of the cavity and the amount of retention obtained within the cavity, while in other cases the retention will greatly depend upon the preparation of the marginal walls to make an interlocking effect on the inlay when seated.

In describing the preparation of cavities in these teeth, where the inlaying process is most applicable, take, for example, a large proximo-occluding cavity, of considerable depth, and where also the occlusal surface has been destroyed deeply towards the central fossa.

FIG. 60

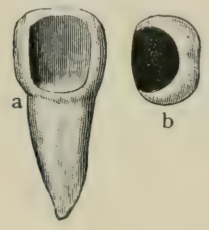


FIG. 61

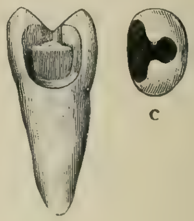


Fig. 60 shows the outline of the cavity described. As has been said before, no definite angles are used in the preparation of cavities for inlays, while in cavities where foil fillings are used definite angles are advocated, to allow a better chance for anchorage in adapting the filling material and also admit of extension for the prevention of decay.

In forming the basal or gingival surface, it should be shaped in such a way that an impression can be taken of this remote part with accuracy and that the inlay can be passed into the cavity without any difficulty and also allow a firm seat for the inlay to rest upon, therefore, this surface should invariably be cut flat.

At the junction of the gingivo-labial and buccal surfaces the cavity should be cut in a rounded form, as indicated in Fig. 60 (a); by cutting this portion of the cavity in this manner the matrix or wax impression can be driven more accurately to that part, for if it is made square at this point it may possibly cause a defect in the inlay. For foil fillings cutting the cavity square in this situation allows greater security for wedging the particles of gold, and at the same time making extension for the prevention, whereas the inlay is inserted in one solid mass; the retention will depend also on the intervention of cement for security and the prevention of recurrence of decay is to a considerable extent effected. Cut the bucco-lingual walls perpendicular, or nearly so, in order that the borders of the cavity may converge slightly towards the basal surface. The morsal surface of the cavity is prepared according to the degree of retention required, for in deep cavities the side walls will give considerable lateral support to the inlay. The depth of the cavity will also increase the cleavage surface of cement, and in case a core is used at the base of the cavity extension attachments may be made on the inlay for the purpose of retention. In this event the occlusal surface should be cut in a crescent shape as shown in Fig. 60 (b).

Where the cavity has not such good retention form as in the above mentioned case, and where greater retention is desirable, a dovetail extension can be made on the occlusal surface, cut in the form of a step, at right angles with the axial line, which will lock the inlay to the enamel walls and prevent its dislodgment when introduced in the cavity.

The extension in the enamel surface should be made in the direction of the central fossa, at which point the tooth tissue is, as a rule, defective. It is usually advisable to limit this means of retention to one extension, as by the use of more it will only complicate the technique and demand a more elaborate preparation of the cavity edges. This extension should be made of sufficient width to allow, in case a matrix is adapted, of burnishing to this part accurately or in taking a wax form to withdraw without distortion. To make this extension (Fig. 61), a fissure bur may be used. The operation of making this extension should be very carefully performed, as the fold or cap of dentin which forms a roof to the pulp is intensely sensitive on the application of the drill. Fig. 61 (c) shows the outline of the occluding surface.

In some cavities, even where a dovetail extension is made, a greater security can be had, especially in deep cavities a strata of cement may be used, and built up in the cavity as the depth will allow; this will give a greater means for retention, such as the attachments of pins or loops to the inlay.

In some cavities where the buccal and lingual walls are considerably destroyed, they should be cut as near perpendicular to the axial line as will permit, as indicated in Fig. 62, terminating in an abrupt curve with the gingival surface. In this case gingival surface is extended bucco-lingually, thus allowing a greater surface for the seat of the inlay.

From the buccal and lingual termination of the occluding surface the cavity can be cut so as to give a slight lateral support to the inlay as shown in Fig. 62 (d), then the step for the dovetail extension can be carried according as the occluding surface of the tooth will admit.

FIG. 62

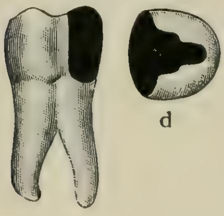
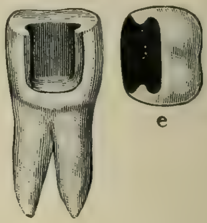


FIG. 63



In some cavities, especially molars in proximal surfaces, where it is necessary to cut through the occluding portion, and where it is not advisable to cut back into the central fossa which terminates in a strong wall of enamel, an anchorage can be nicely made by cutting circular grooves perpendicular to the axial line along the buccal and lingual surfaces. This can be easily done with a fairly good size fissure bur, and making the cavity wider bucco-lingually at the occlusal than at the gingival margin. Fig. 63(e) adequately describes this form of cavity preparation. Using this method of security for the inlay will prevent it from becoming dislodged laterally, and the only way it can be removed is occlusally. Before finally setting, the inlay undercuts should be made in the cavity walls to further increase the binding effect of the cement.

It is very requisite that the operator should aim to obtain such security for inlays that the greatest possible stress of which the jaws are capable will not dislodge them, and this can usually be obtained by the double security given to gold inlays by cavity preparation and the various attachments used on the inlay for retention.

Fig. 64

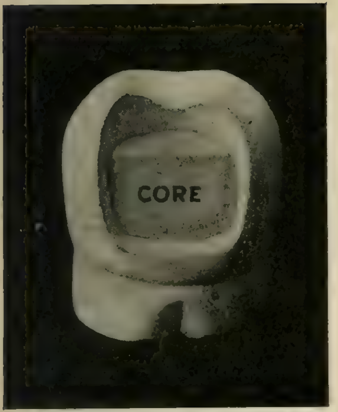


Fig. 65

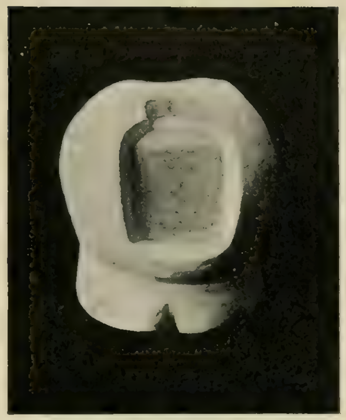


Fig. 66

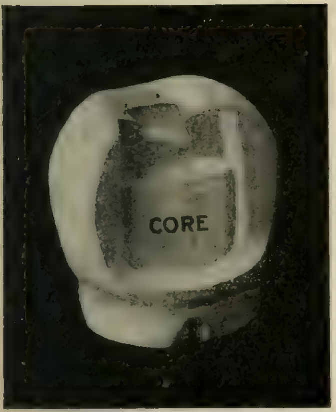
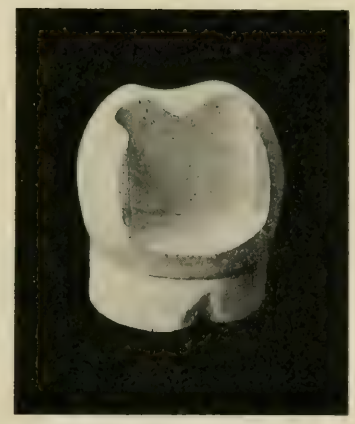


Fig. 67



Figs. 64, 65, 66, 67 — Cavity formation of molars and bicuspids showing " core " in position in deep cavities.

CAVITIES LOCATED ON THE BUCCAL AND MORSAL SURFACES OF MOLARS AND BICUSPIDS

Cavities located on the buccal surfaces of molars and bicuspids are treated in a manner similar to those already described for cervical cavities for incisors. The filling of this class of cavities with cohesive gold presents many times considerable difficulty, owing to their position and also the great amount of moisture to overcome in this situation, but by adapting the inlaying process these difficulties are considerably lessened.

FIG. 68

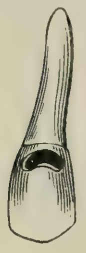


FIG. 69

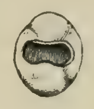
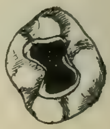


FIG. 70



The formation of the cavity and the means used for security are similar to those adapted for cervical cavities of incisors. (Fig. 68.) The preparation of cavities upon the morsal surfaces of molars and bicuspids will depend, of course, on the situation and the extent of the infected tissue. In bicuspids the decay usually begins in the fissure between the cusps, the enamel many times presents a dark line, while in other instances the cavity has increased greatly in size, caused by the underlying portion of enamel being affected, and the disintegration of its margins from caries, so that the cavity can be sufficiently enlarged to be suitable to be inlaid with gold. Cavities upon the morsal surfaces of bicuspids and molars are the most simple ones to be inlaid.

In the formation of the cavity a tapered fissure bur may be used to enlarge the orifice, and in cavities of larger infected area chisels may be used to cut away any overhanging margins. After the cavity has been opened in this manner all infected tissue should be removed, and this is best accomplished with round burs. The preparation of the marginal edges should receive special attention. In the formation of the marginal edges the sulci should be cut away so as to remove all infected tissue, and the terminal pits should be made in a rounded form, and the whole cavity orifice so enlarged that an impression can be taken without difficulty. Fig. 69 shows the formation of these cavities. All angles should be removed and the marginal edges should present a series of graceful curves.

In finishing the marginal edges, fine tapering stones may be used together with fine cavity burs. On the morsal surface of upper molars there are two places usually affected by caries situated on either side of the oblique ridge, and in many instances the enamel so affected between them requires the removal of the intervening tissue, the whole cavity thus being greatly enlarged and the cavity formed, as shown in Fig. 70.

In lower molars caries is usually found at the union of the sulci between the four cusps. If the terminal margins at this intersection be left sharp, as in Fig. 71, the pressure of the molten gold flowing over sharp extensions within the mold may be broken away and the particles of investment that have become dislodged would cause a defective cast and a misfit of the inlay. Fig. 72 represents the sharp angles removed and the marginal edges of the cavity correctly prepared.

FIG. 71

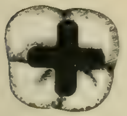
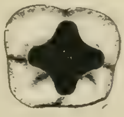


FIG. 72



In deep cavities of this class an intervening strata of cement or temporary stopping may be used; this will prevent the wax impression being forced to the extreme depth of the cavity, and will thus allow a means for the attachment of pins to the inlay for security.

In case a matrix is used to form the inlay, the gauge of metal used should be thinner than that used for larger restorations, as it will be much easier to manipulate to the cavity. Cavities in this locality are, however, better made by the wax dispersion method.

The formation of the cavity should be a guide for the placing of the inlay in the cavity, as a round cavity formation may be difficult to seat, unless an extension is left on the filling as a guide to indicate its proper position.

THE RESTORATION OF THE MORSAL SURFACES OF MOLARS AND BICUSPIDS

Bicuspids and molars, where there is considerable loss of crown surface caused by caries or abrasion, can be restored by the inlaying process and with greater security to the inlay than any other filling used. The process also lessens the destruction of enamel required in the preparation for a band crown. In vital teeth, where only a portion of enamel has been destroyed, pin attachments can be made to the inlay. (Fig. 73.) Holes are drilled into the occluding surface according to the size and length of pins used, care being taken, of course, not to encroach too closely upon the pulp.

If a matrix is used to form the inlay it should be burnished over the entire surface and allowed to slightly overlap the marginal edges: Platinum pins or wire of suitable size and length are forced through the matrix into the countersunk holes made in the tooth. The matrix and pin attachments are removed by the impression method, then invested and finally contoured to the proper form. In case the inlay is made by the wax dispersion method the pins are placed in an upright position in the tooth, then the wax is formed over the occluding surface, contoured to form and correct articulation, and then removed, together with the pins, invested and finally cast. Where teeth have been devitalized, security can be had for the inlay by the use of pins inserted in the root canals in an upright position as shown in Fig. 74, the pins are cemented permanently in this position, the wax is contoured in the usual manner over the whole surface; the wax is removed and in the depressions in the wax made by the pins graphite points are inserted and left in this position until the casting process, then removed to form holes for the reception of the pins when the inlay is inserted in place.

FIG. 73

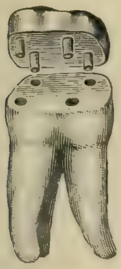


FIG. 74

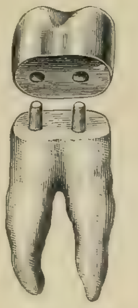
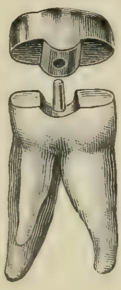


FIG. 75



In some cases the reception of the occlusal surface will give better security to the inlay by cutting a cradle formation for the inlay to rest in when seated (Fig. 75), and a post attachment can also be made in the pulp chamber by cementing it in place, as shown by the accompanying cut.

These forms of inlay are very suitable as abutments in bridge work, and by less destruction of tooth tissue overcome the irritating results to the gum on the insertion of band crowns.

The application of these more recent attachments to bridge work, such as hoods, partial caps, and molded fillings, prove of great advantage as a substitute to ferrule bands and crowns. With such attachments it is gratifying to note the strong support that can be obtained in an extensive piece of bridge work, with better results, in some cases, as the vitality of the tooth is preserved and the margin visible and accessible to any future disturbance.

THE USE OF INLAYS AS BRIDGE ABUTMENTS AND OTHER ATTACHMENTS

By the principle of constructing fillings by the inlay process has been developed the idea of making large restorations in bicuspids and molars, with the further outcome of their successful use as anchorage and abutments in bridge work. The practical application of inlays when used in this manner prevents the destruction of a large surface of tooth tissue, thereby doing away with the useless and objectionable display of gold. For this reason, where this process is permissible, it is very much superior, as being more æsthetic than other substitutes in bridge construction. In fact, when used for partial crown or bridge attachments, it is more hygienic and less liable to disturb the vitality of the tooth, because possessing a non-irritant effect. The application of this principle of filling may be used also in binding together teeth that have lost their stability through the inroads of pyorrhœa alveolaris, thereby making them useful organs for many years. They can also be used to successful advantage in making attachments in orthodontia operations, and used also in prosthesis as attachments for partial dentures.

Abutments.— The first consideration as to the application of the inlay process for bridge abutments should be a definite calculation as to the amount of security required to overcome the force of occlusal stress; when this has been determined the utility of this method of constructing bridges is assured.

In bicuspids, where there is a loss of either the lingual or buccal cusp caused by extensive decay or by fracture from violence, the hood attachment is most applicable for restoring this condition and will give a chance for a bridge anchorage. In devitalized teeth a post attachment can be made in the root canal (Fig. 76) and then the whole surface be cast to the proper contour.

In vital teeth, where the anchorage is more limited, pin attachments can be made to the inlay; in order to make the pin attachments, holes are drilled into the surface of the tooth in such a position and of such depth as not to impinge too closely to the pulp. Fig. 77 shows the locality of the retention to be used for the pin or staple attachments.

Over the prepared surface .001 gauge is burnished to approximately fit, then it is removed and trimmed to slightly overlap the marginal edges; it is replaced and accurately burnished to all parts then the pins are forced through the matrix into the retaining holes. After the pins are placed in position the whole attachment is removed in compound, then invested in plaster and finally the compound removed, then the contour cast as required with 22-k. solder. In the event that this restoration is not made until the final casting of the whole bridge, the pins should be soldered to the matrix; this will prevent a displacement taking place on the removal.

In bicuspids where it is desirable to hide from view any display of gold and where it is impossible to make any attachments, a hood inlay can be formed by cutting away either cusp, usually the lingual cusp preferred, as it will avoid any display of gold. The cusp should be cut away so as to give sufficient body for the attachment, but not enough to injure the vitality of the tooth.

FIG. 76

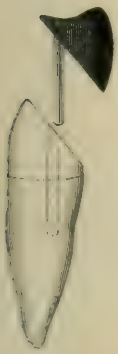


FIG. 77

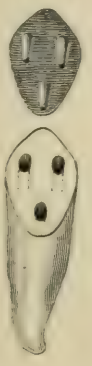


FIG. 78

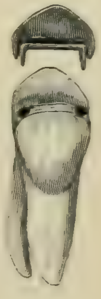
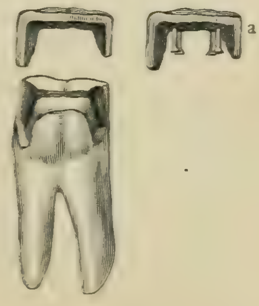


FIG. 79



The next step is to make the grooves mesio-distally across the central fossa, the size and depth according to the gauge wire used. Near the extreme ends of the grooved surface, holes are drilled to receive the attachment, the wire is bent near the edge at right angles, so as to pass into the holes when adjusted into the grooves — these staples will increase the security of the hood. After the wire is fitted accurately into the groove the matrix is swaged over the wire and the entire prepared surface of the tooth; it is then removed and contour formed. In case that staples are not used cavities can be made on the mesial and distant surfaces, or in case they exist they can be prepared in the usual manner to receive a gold filling.

This form of hood is adequately shown in Fig. 78.

In deep proximal occluding cavities, especially in molars where security can be had into the pulp chamber, a tube attachment is cemented permanently in an upright position, so that the wire or post anchorage, which is attached to the matrix, will accurately pass within the already cemented post.

In order to prevent the inlay from extending to the base of the cavity a core of cement is built up on a level with the post, which is removed before the final setting of the bridge.

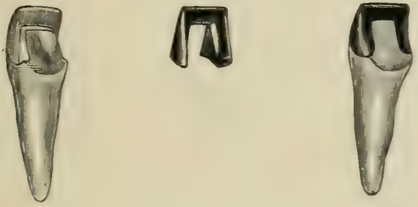
In complicated cavities in bicuspids and molars, where there is a complete loss of tooth tissue in the central fossa, this forming an entire separation of the cusps, the saddle inlay can be used with success, as a great range of security can be given for the attachment of pins, posts, or loops. In the preparation of the cavity the entire occluding surface can be ground away, making the surface slightly concave and the proximal surfaces cut away bucco-lingually towards the cervical margin, cutting the margins to bevel slightly towards the occluding surface. It is advisable to flatten one or the other of the standing cusps, when separated by considerable decay, in order to form a firm seat for the inlay to rest on and also to prevent splitting of the tooth when subjected to occlusal stress. Fig. 79 shows the form of cavity and inlay ready to be inserted in place.

Where it is an advantage to have greater security to the inlay attachment pins or loops may be made to the inlay. This can be done by removing the matrix and imbedding it in some softened compound; then holes are drilled through the matrix in suitable position, the pins are then inserted in the holes and extended from the matrix as the depth of the cavity will allow; in this case a core of cement is used at the base of the cavity to construct the matrix over and, previous to the insertion of the inlay attachment, it is removed to allow a reception for the attachments. (Fig. 79 (*a*).)

In case where an entire envolvement of the occluding surface is presented the whole surface of the crown can be ground down to healthy tissue; on the surface are drilled retentive holes for the insertion of pins. An inlay cast to this surface will form a complete cap to the occluding surface.

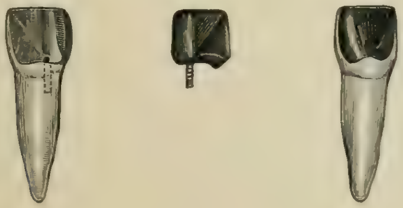
In making inlay attachments to incisors the same principle is carried out as already stated, to secure artificial substitutes, for in some instances it would be impossible to restore such conditions without the sacrifice of a large extent of tooth structure, but by making attachments in the form of inlays, hood, and saddle attachments this difficulty is overcome.

FIG. 80



Where there is approximal envolvement of the tooth, the cavities can be extended to increase the area of support, so that the inlay will have greater support in the cavity, and also extending it across the incisal end, so that there should remain as much of the labial plate of enamel as possible; the approximal margins of the filling should extend a short distance labially, so as to be free from the artificial substitutes and allow sufficient surface for soldering; this form of cavity and filling is illustrated in Fig. 80.

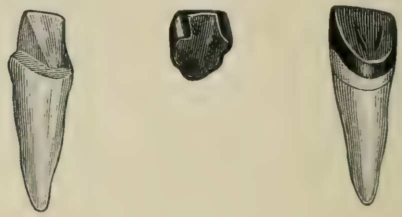
FIG. 81



In some cases, where it is found necessary to make an attachment and where it is necessary to entirely have the gold hidden from view, the lingual aspect of the tooth can be prepared as shown in Fig. 81, and security can be had by a post attachment to the inlay; and, if indicated, a hole can be drilled into the proximal portion of the root, or in a devitalized tooth a post can be inserted into the root canal; this form of attachment can be used very practically in constructing open-faced crowns.

Partial hoods can also be used where indicated, especially to form an intervening support for approximal artificial teeth; Fig. 82 adequately shows the form of cavity formation and the inlay adjusted to the tooth; this attachment may be constructed to slightly envolve the labial enamel surface, to increase its security.

FIG. 82



The restoration of teeth in this manner, either for crowns or abutments, leaves the outer portion of the surface of the crown of the tooth undestroyed; the vitality of the pulp is more likely to be retained and absorption is less liable to occur than when the whole tooth surface is concealed. The advent of this process has made possible the successful construction of bridges that otherwise could not be made, especially in a tilted condition of the teeth, and for saddle partial dentures, where indicated, it can be used to advantage.

The hood inlay saddle extension is a side issue of the gold inlay principle. Dr. Charles L. Alexander states: "Where indicated, these plates, when skillfully made, furnish an artistic and unique substitute. The sanitary aspect is not objectionable, as my observation has proved. These anchor plates are very satisfactory, but doubtless they could be further improved. My opinion is that the Roach ball-and-tube anchorage, used in connection with the hood inlay protection, would make a very desirable improvement."

THE SETTING AND FINISHING OF THE INLAY

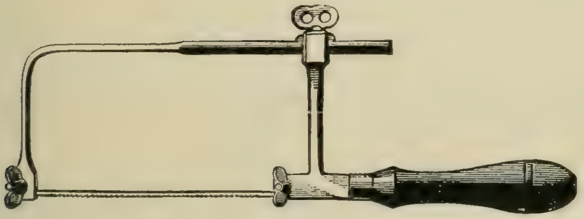
The setting of the inlay is a very important procedure in inlay work, and the utmost care should be taken in every detail to secure the best results. As it has already been said, the security of the inlay will depend upon its accurate adaptation to the cavity and the retention obtained by the intervention of cement within the cavity to hold the inlay in place.

After the casting process, the inlay should be approximately finished in the laboratory before its insertion in the cavity; in fact, after some experience in this way, the filling requires very little finishing after it is inserted in the cavity. Providing the inlay has been constructed by the indirect method, the model can be used to finish the inlay on.

To detach the sprue from the casting it is best removed by a sawing, as by severing it with clipping pliers may have a tendency to draw the gold and thus change the form of the casting.

The mechanical saw illustrated by Fig. 83 is indispensable for this operation.

FIG. 83



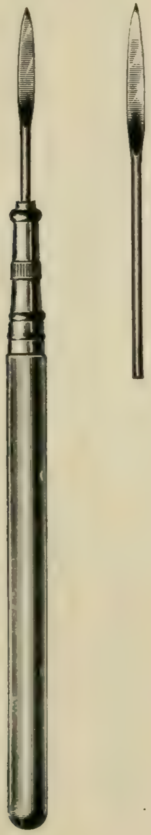
Before inserting the inlay in the cavity it should be carefully examined to see if there are any imperfections upon the cavity surface, for if an accurate facsimile of the cavity is not produced it will cause a misfit of the inlay. The used of a magnifying glass will greatly assist in detecting any imperfections on the inlay. The ease in which the inlay becomes seated in the cavity is an assurance of the accuracy in the construction of the inlay. After obtaining proper adaptation and occlusal contact, the inlay is ready to be cemented permanently in the cavity.

In preparing the cavity for the reception of the inlay, undercuts are made in the cavity walls so as to retain the cement within the cavity, and at the same time grooves can be made on the inlay, if necessary, to further increase the security of the filling. Before the application of the cement to the cavity, the cavity and surrounding tissue should be thoroughly free from moisture; as it has been already said, the rubber attachment may be dispensed with, as a rule, but in some cases it may be used to advantage where the moisture cannot be excluded by any other means. Cotton rolls may be used as a substitute, to preserve absolute dryness sufficient to successfully set the inlay. The cotton dental rolls are supplied in convenient form for plastic work. Dr. W. A. Capon, Philadelphia, Pa., states in regard to the use of cotton rolls: "The introduction of various sizes of cotton rolls has been of incalculable value and has done much towards the reduction of unpleasantness inseparable from the use of the rubber dam, but the great majority are unaware of still greater possibilities of the roll because they have not given it proper consideration, such as assistance of various non-irritating clamps and tongue compressors."

In mixing the cement for inlay operations it should be brought to such consistency that it is easily forced to all parts of the cavity on the introduction of the inlay. A large glass slab should be used upon which to mix the cement, with sufficient powder and an equal amount of liquid, the powder being gradually incorporated with the liquid by drawing the powder into it little by little. When the mass has become thoroughly mixed it is spread freely over the surface of the slab; it is well to neutralize all the acid in the mass, as by not doing so it may act as an irritant to the sensitive cavity. Care should be taken to obtain the proper constituents, as the stability of the cement may be affected. The shade of cement to use will be governed by the color and translucency of the tooth tissue. Copper cement may be used in some cases where preservative qualities are required, and especially where fillings are hid from view may be used to advantage; but owing to its blackness, it should not be used on exposed surfaces. The miniature spatulas, as shown in Fig. 84, are excellent instruments to convey the cement into the cavity and to the inlay, and can be had from supply houses in various sizes.

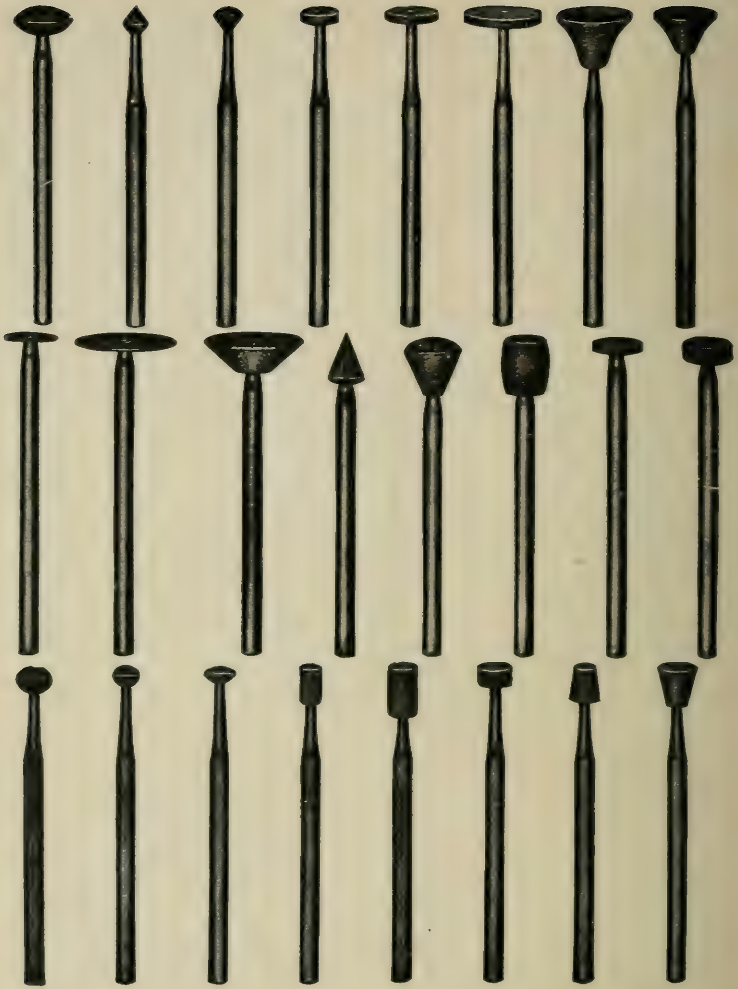
In setting the inlay, it should be gradually forced into the cavity, so as not to dispel any more than the surplus cement; the inlay is then finally driven in place by the use of orange-wood sticks. The inlay should be held firmly in place until after the setting process.

FIG. 84



In fact, throughout the whole finishing process, the inlay should be firmly held in place. In selecting cement for the setting of the inlays preference is given to the kind prepared for that purpose, as it is much finer and possesses greater adhesive qualities. The operation of finishing the inlay is accomplished by the use of stones, finishing burs, and disks, after which the filling can be finally burnished.

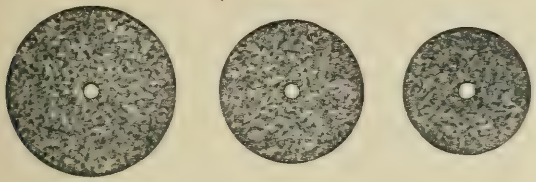
FIG. 85



There are to be had some excellent forms of stones that can be used for cutting away the surplus gold. Fig. 85 shows some of the convenient forms. The stones, as illustrated in Fig. 85, are made by the Carborundum Company, at Niagara Falls. They are made of green carborundum, which excels other forms made in cutting quality. These stones are supplied to the profession by Lee S. Smith & Son Co., Pittsburg, Pa.

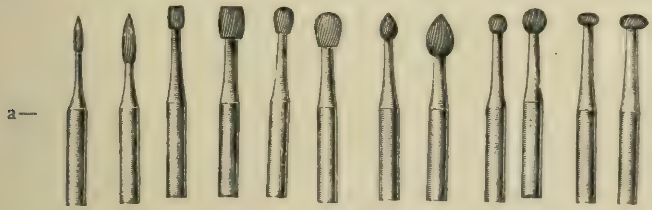
For cutting proximal surfaces of inlays, excellent advantage is obtained, especially where the space is limited, in the use of Case's abrasive disks, as they are made very thin and flexible and readily adapted to these surfaces. These disks are made of steel with electro deposit on one side, as shown in Fig. 86.

FIG. 86



Some of the cavity finishing burs are very adaptable for finishing the inlay in places where the stones cannot reach. (Fig. 87.)

FIG. 87



In using the finishing stone and burs, allow them to revolve in the direction of the enamel edge, to admit the gold to be burnished in the direction of the cavity border, and also to direct the force against the cavity walls. In finishing the inlay in the direction of the gingival edge, cone-shaped stones and burs are used, as they are more accessible in that situation. Fig. 87 *a,* designates the forms used.

The occlusal surfaces should be finished accurately, so as to get the correct contact to equalize the stress upon the inlay and thereby prevent its dislodgment.

THE PROCESS OF CASTING INLAYS BY THE PRESSURE METHOD

By the advent of casting gold inlays by the pressure method, a wonderful change has been made in the *modus operandi* of constructing fillings by the inlay process. It has been the outcome of a vast amount of consideration in the technique of their formation. The process of casting has also been extended to the field of prosthesis.

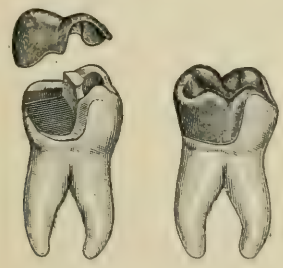
The introduction of this newer method of fusing gold inlays under pressure has created a still greater belief throughout the profession in the utility of gold inlays in preserving and restoring tooth structure; this is evidenced, also, to considerable extent by the many operators who are successfully using the matrix method of constructing inlays.

This method of constructing inlays has given a greater range in their use, and has lessened also the technical difficulties of their preparation. Most excellent results, however, have been obtained by the former method of making inlays by the matrix system, so much so, that it will always form a part in the technique of inlay operations. Personally, I have used so successfully, and with such gratifying results, the matrix method that I do not consider it wise in all cases to entirely abandon it. No doubt in the future it will still play a part in the construction of gold inlays where indicated. However, the casting process has much broadened the field for this class of operations.

The devices used for the fusion of gold by the wax-dispersion method ranges from complicated structures to some of the most simple forms. The various casting devices that have been originated to successfully perform the operation are by the use of nitrous oxid, compressed air, exhaustion, and steam, all producing excellent results. To obtain the best results in casting, the application should be so mechanically regulated that a definite amount of pressure can be obtained to force the gold accurately to all parts of the cavity; but when devices are used where no definite calculation is allowed as regards pressure it may result in unsatisfactory consequences in not producing an accurate facsimile of the wax, by virtue of a pressure either insufficient or too great to successfully cast the inlay.

In constructing cast-gold inlays there are five operations: 1. Preparing the cavity. 2. Obtaining a wax inlay model. 3. Investing the wax model in a flask. 4. Dispelling the wax from the mold. 5. Casting the inlay. It is hardly necessary to recapitulate the general principles of cavity preparation for gold inlays, but it should be understood that there is no difference in the formation of cavities for cast fillings from those made by the matrix method. As has already been said on cavity preparation, all angles should be eliminated — that is, straight lines should not terminate too abruptly in short curvatures, for in forcing the wax into such remote parts it may possibly fall short of reaching such angles formed, or, in the event that sharp angles are left, the pressure exerted upon the mold in the operation of casting may result in destroying the sharp angles or extensions by the sudden flow of gold against them, thus making a defective fit of the inlay.

FIG. 88



In providing retention against stress to which the fillings are subjected, the same methods are adapted as those described in the matrix method of forming inlays. The amount of retention required will depend on the amount of stress. In order to describe the casting process a cavity as shown in Fig. 88 may be taken.

Obtaining a Wax Model of the Cavity.— In the formation of the wax model there are two methods used: One in which the wax is placed directly in the cavity of the tooth in the mouth and carved to proper shape and contour; the other, by taking an impression of the cavity, constructing a cast and forming the wax model thereon out of the mouth. The more expedient way, as a rule, is to form the wax inlay in the mouth, but there are cases where it would be advisable to take an impression of the cavity and form the model by the indirect method.

If an accurate impression is taken of the cavity, the result will be that an accurate fitting inlay can be had by adopting the indirect method; there is a disadvantage, of course, in doing so, as it takes more time. The technique of forming models has been already described in this series of papers, and the reader is referred to that part of the subject.

Before commencing the operation of taking a wax inlay of the cavity, the nature of the wax should be considered; it should possess such nature that it can be easily manipulated into the cavity, possessing sufficient hardness to be worked without difficulty to the form required. There are some excellent wax preparations on the market which meet all requirements. The colors that have been selected are of the darker shades, to form a ready contrast with gum and tooth tissue.

I have been using wax in various colors, and find a pink tint is more transparent than the green, which is a very essential point, as the margins of the cavity can be easily seen and the thickness of the wax can be determined, overlapping the marginal edges.

To test the transparency of wax in various colors I made thin slices of equal thickness, and found that the pink-colored transmitted the light more than the green, and the latter had to be cut very thin before any transparency could be detected.

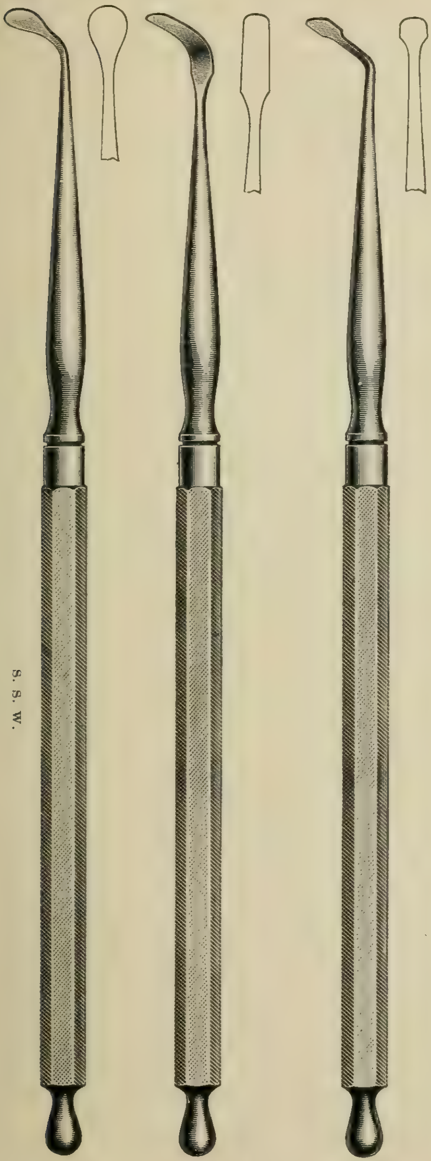
Preparing the Wax Model.— To make the wax inlay in the mouth it should be of such consistency as to retain sufficient solidity so as not to become distorted in its manipulation at the ordinary temperature of the mouth.

The cavity to receive a wax inlay should be so formed that the wax can be easily inserted in the cavity and carved to proper contour, and also admit of an easy draw therefrom without affecting its shape.

The procedure of taking the impression is the most difficult operation in the preparation of cast inlays. The wax is first warmed in tepid water, so that it will become thoroughly softened; then dry heat is applied to dispel any surplus moisture. Then the wax is formed to the size of the cavity and pressed to place with the fingers, so as to drive it to all parts of the cavity. To secure the wax in place it should be forced towards the cavity margins. In many cases, in order to prevent the wax from being forced to the extreme base of

Fig. 89

THE AUTHOR'S PLASTIC CARVERS



the cavity, a " core " made of cement or stopping may be used; this will prevent the extension of the wax to the full depth of the cavity and allow a very much easier draw of the wax. In carving the wax to the proper contour it can be made with thin bladed plastic instruments (Fig. 89), leaving enough wax to thinly overlap the marginal edges. To obtain the occlusal contact, the patient may be allowed to bite, to show the anatomical landmarks; this is a very essential point in the preparation of the wax inlay, as much time and labor will be saved in the finishing process. A filling that has an abnormal articulation may possibly cause irregularity and disease.

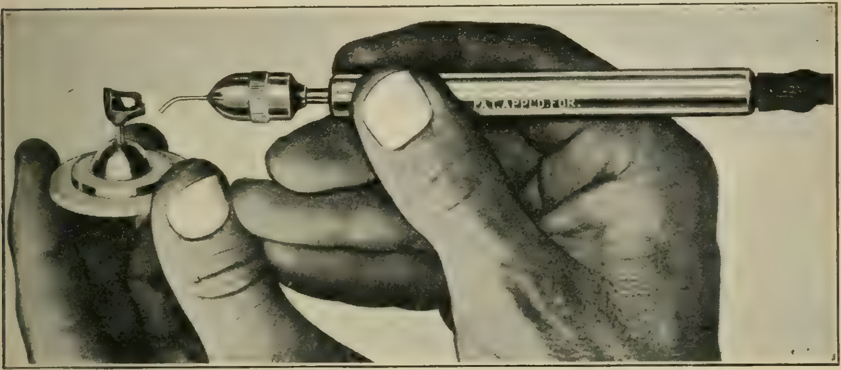
After the wax form has been removed from the cavity it should be carefully examined to see if there are any imperfections, and providing the wax has fallen short of the marginal edges, it should be discarded and another one formed. To remove the wax inlay from the cavity it should be teased therefrom with a fine-pointed instrument, or, in case of large restorations, the sprue wire may be inserted in the wax while in the cavity. Usually the moisture in the cavity is sufficient to allow the wax to be removed without adhering too closely to the cavity, but, if it is necessary, some talcum powder may be used. The wax should be of such texture as to admit of removal and allow carving, as the case requires.

As the wax model is to be entirely enclosed in an investment, the wax should be thoroughly refined, so that it will be capable of complete volatilization and be readily absorbed under the action of heat, leaving no residue to cling to the sides of the mold and thus make an imperfect cast of the inlay.

When the teeth are in normal position it is not necessary to do any wedging, because a close contact can be obtained to the opposing tooth in making the contour. To force the wax into all the inequalities of the cavity a tape or celluloid strip may be used, by passing it down between the teeth and applying slight pressure towards the marginal edges. To form the contour, suitable carving instruments may be used. A stream of cold water passed over the wax will harden it sufficiently to allow carving to shape and contour. After the wax has been removed from the cavity, care should be taken in its manipulation so as not to distort the fine marginal edges.

To form the hollow retention in the inlay, the end of a small chip blower may be used by heating it and then drawing the softened wax into it. By this means a cavity is easily formed into the wax, care, of course, being taken not to approach too closely to the marginal edges. Fig. 90 illustrates a device, the invention of Dr. F. E. Roach, of Chicago, provided with a bulb, whereby the point is sufficiently heated to melt the wax to form the hollow retention; suction modifies the heat and removes the surplus wax. The wax is drawn up the tube and absorbed by the cotton within the container.

FIG. 90



Investing the Wax Inlay.— Before going into the technique of investing the wax model, some attention should be given as to the nature of the investment and also its manipulation to produce the best results. It is quite apparent that plaster alone is insufficient to use as an investment, as the expansion and contraction are so great that it would be unfit for casting metals. It requires, therefore, an additional material to overcome this condition. It has been stated by good authority that the expansion of plaster increased up to 300 degrees F., and after that a very decided contraction, and finally it becomes disorganized about 1,100 degrees F. Under such behavior the plaster requires an additional material to overcome this decided change, thereby making an investment that will be sufficiently stable to produce a facsimile of the wax model. To obtain such a condition the incorporation of very finely powdered silex and plaster may be used in such proportions that the mixture will withstand the pressure in casting. The proportions in which these ingredients may be mixed, for ordinary pressure, are of equal parts of each, but this will be governed by the amount of pressure used in casting.

I may invite your attention to an article by Dr. Weston A. Price which has recently appeared in our journals, dealing scientifically with the nature of investments and casting of metals.

The manipulation of the investment has a great deal to do with success in casting the inlay; it should be mixed to such a consistency as to overcome shrinkage. If mixed too thin and allowed to stand for some time the shrinkage will be considerable — the gold cast in such a mold at low pressure will cause a distinct variation in size, owing to shrinkage. If a high pressure be used to overcome this shrinkage it will result in distortion of the investment and the production of " beads," which will cause a misfit of the inlay.

In order, therefore, to obtain a perfect filling there must be an expansion of the investment material to make up for the contraction of gold. It is advisable to invest the wax form as soon as possible after it is removed from the mouth, so that the thin portions of the wax will not become distorted by extreme temperature.

Price's artificial stone for models to support the castings may be used to advantage, as it allows a hard smooth surface to cast upon that will withstand any pressure exerted on the mold in casting, and thus prevent the possibility of affecting its shape and producing pitting of the cavity surface. In using artifical stone for this purpose an impression is taken of the cavity and a model of this material is obtained, the wax inlay is constructed thereon to proper shape and contour, then the model and wax form are invested in the usual way. There is an advantage in using a mold of this nature, as the frail or thin walls of the mold will withstand the pressure of casting, even at high pressure, thus yielding a facsimile of the wax form.

In mixing the investment it should be of such consistency as will readily flow to all parts of the model, and be entirely free from air bubbles. After the wax inlay has been removed from the cavity the sprue wire is slightly heated at the point and inserted into the body of the wax, care being taken to have it sufficiently imbedded so as not to become detached and also in no way affect the marginal edges. This is very liable to occur in small wax forms. The size of sprue wire used for inlays is usually about 17 gauge, but the size wire to be used will be governed by the extent of the cast.

In large restorations, such as for bridge attachments, more than one sprue opening may be used in order to equalize the flow of gold to all parts of the mold; wax may be used to take the place of the wire and several may be formed to the wax restoration radiating to one common center to form the chute opening.

FIG. 91

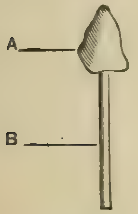
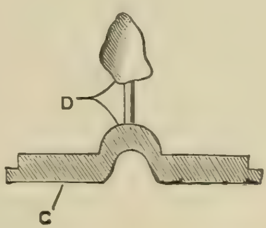


FIG. 92



Providing the wax is not forced to the extreme depth of the cavity, the sprue can be inserted into the cavity side of the wax form; this will form, after the casting, an extension on the inlay for retention. After the wax is secured to the sprue wire (Fig. 91, A and B), it is then passed through an opening in the center of the cover of the flask. (Fig. 92, C.) The interior of the cover is hemispherical or cone-shaped, this forming a crucible depression in the investment. The wax pattern is inserted about one-fourth of an inch from the cover, as indicated at D.

In selecting the flask for investing it should be in accordance with the size of casting and sufficiently rigid to hold the investment securely during the heating and casting process. To secure the sprue wire in this position some wax is applied around the wire on the upper surface of the cover.

Fig. 92 shows the wax form in position ready for the investment. As has been previously stated, the investment should be mixed to a creamy consistency, all air bubbles should be excluded, and this can be done by revolving and jarring the bowl while in the act of mixing. In applying the investment around the wax, care should be taken to force the investment to every part of the wax form; this is best accomplished with a small spatula or a camel-hair brush.

FIG. 93

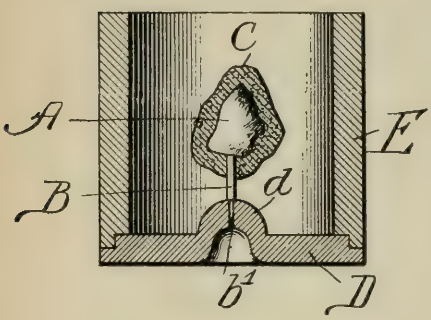


FIG. 94

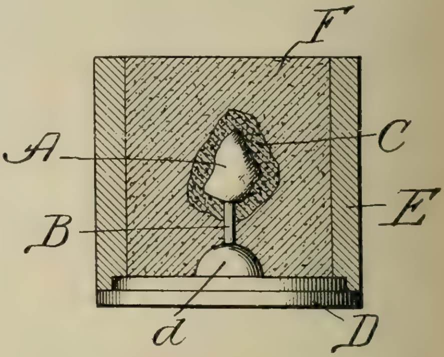


FIG. 95

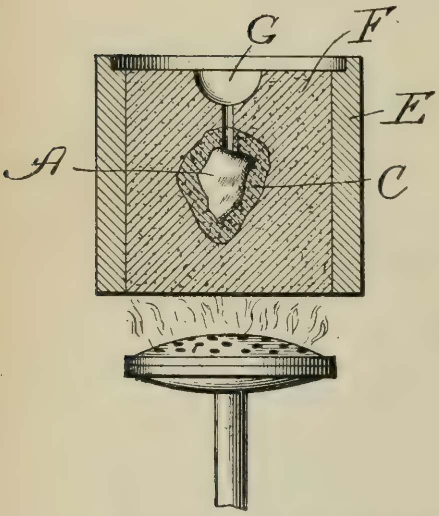
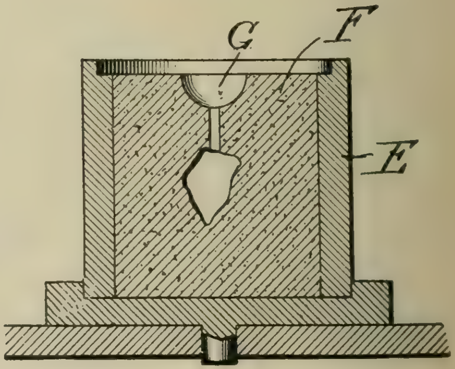


FIG. 96



Figs. 93, 94, 95, and 96 (after William H. Taggart), *A*, wax form of cavity; *b*, sprue former; *C*, investing material; *d*, cover with crucible formation; *E*, flask; *F*, investment surrounding primary body; *G*, crucible depression in the investment for melting the gold.

The mixing of the investment is a very important procedure. If mixed too stiff it will cause distortion of the wax form and thus cause a defective inlay.

In filling the flask with the investment a surplus amount should be used, so that the flask will be entirely filled and the investment material ooze from the openings in the flask. The flask should then be carefully jarred and rotated so that the investment will be driven to all parts, and also be entirely free from air bubbles.

Fig. 93 shows the primary coat of investment and also the flask filled with same.

Dispelling the Wax from the Mold.— The investment is now left to dry gradually. The time required for the setting of the investment is from fifteen to thirty minutes. It can be placed aside for an indefinite period without injury. It should always be allowed to remain until no free water is driven off in the heating process. After the investment has sufficiently set the sprue wire should be heated before removal. This will readily detach it from the wax, and a slight rotation should be given it so as to draw it from the investment without destroying the mold.

FIG. 97

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The cover is then removed, leaving the investment in a crucible form for the melting of gold. (Fig. 95, G.)

To dispel the wax from the investment, the flask should be placed over a low heat on a convenient heating device. (Fig. 97.) Owing to the absorptive quality of the investment, the wax, after being melted, is driven into it, and inverting the flask will allow the wax to be displaced through the chute opening. Fig. 96 represents the mold ready to receive the casting.

The flask should not be overheated, nor carried to such an extreme temperature as to destroy the stability of the investment.

Casting the Inlay.— The process of casting metals under pressure has long been known in dentistry, for the application of this principle has been carried out in the construction of aluminum and fusible dentures,* but the idea of casting inlays made of pure gold was first introduced by Dr. William H. Taggart, of Chicago, who, on January 15, 1907, at the Odontological Society of New York, made known to the profession his process of casting metal fillings under pressure, and also intimated some of the possibilities of this process being used in crown and bridge-work operations.

In order to force the molten gold into such a mold already described, it requires a pressure exerted on the metal in the molten state to overcome the atmospheric pressure of air within the mold; that is, the force on the gold must more than equalize the air within to allow it to flow readily to all parts.

The Taggart Method of Casting.— The appliance used for the casting of inlays by the Taggart method consists of a nitrous oxid blowpipe to melt the gold, compression being made by the discharge of nitrous oxid gas from a cylinder containing the same.

The machine is equipped with a gas reservoir, and also a gauge to regulate the flow of nitrous oxid, so that the pressure may be in proportion to the mass of metal to be cast.

In casting, the mass of gold is placed in the crucible in the flask, and subjected to the melting process by the use of the nitrous oxid flame; the attachment of the blow-pipe is then lighted and turned directly down on the mass of gold in the crucible.

Owing to the intense heat generated by the gas, the gold melts very rapidly to the boiling state; when the mass of gold reaches the fusing state, the lever is instantly thrown down and the blowpipe is then automatically switched off; the pressure of the gas on the molten mass forces it into the mold and thus makes the casting.

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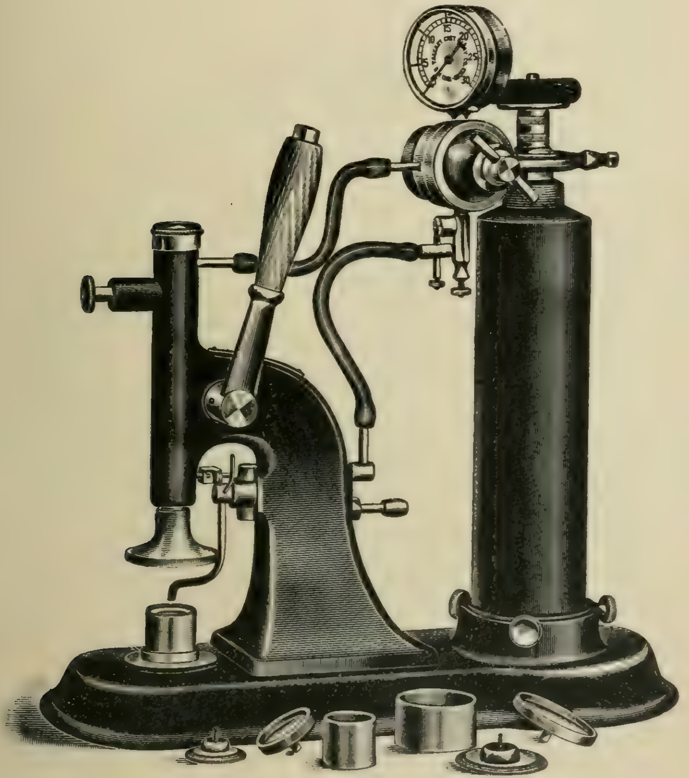
*Garretson's Oral Surgery, 1890, page 665.

Attached to the reservoir is an automatic whistle to indicate to the operator that an unnecessary escape of gas is taking place. The assembling of the various parts of the casting machine, with all its parts well thought out, demonstrates the exceptional mechanical ability of the inventor.

Fig. 98



Soon after Dr. Taggart had introduced his method of casting fillings under pressure, other inlay operators also became interested, and the outcome was that various methods of casting were adopted,

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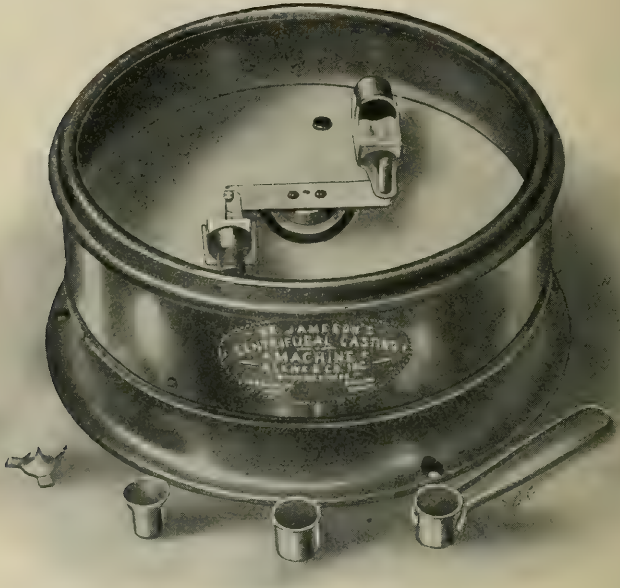
such as centrifugal force, compressed air, and steam. Some of these were of more simplified design and equally efficient in operation.

The Jameson Centrifugal Method of Casting.— By this method of casting, the molten gold is thrown into the mold very effectively by centrifugal motion, and the pressure to which the mold is subjected will depend on the velocity. This process of casting metals, also, is by no means new, as it has been used in the arts, in making various objects. The appliance for casting inlays (Fig. 99), consists of a centrifugal arm upon either end to support brackets containing the cups or buckets.

FIG. 99



On the most remote bracket of the centrifugal arm is mounted the cup containing the mold, with the wax previously burnt out; on the other bracket, nearest to the handle that swings the machine, place a cup filled with plaster. The machine is then wound up by the handle on the centrifugal arm, by turning it to the left, when it is ready to be set in motion to do the casting.

On the rim of the machine is placed a velocity drag to set in motion the arm and to control the speed. On the bracket slide, opposite the chute opening in the mold, is placed a button of gold; heat is applied by means of a blow-pipe until the metal becomes completely fused; the drag is then released and immediately the arm is set in motion and the metal thrown into the mold. It is essential, of course, to arrange the cup and the counterweight at right angles with the centrifugal arm, so that both face in the direction in which the machine is set in motion. To make small inlay restorations the machine should be wound no more than sixteen revolutions, but this will depend on the extent of the cast. The larger the casting, the less speed required. Excellent results are obtained by this method of casting, but care should be taken to regulate the peripheral speed.

Compressed air can be used in the same manner as nitrous oxid; a tank is charged with air, the kind used with any compressed air outfit; a reservoir is attached to the tank which is filled with air according to the pressure required. The amount of air necessary for casting is registered by a pressure gauge attached to the reservoir. Accurate results are obtained by this method, as a definite amount of pressure to force the gold into the vacant mold can be obtained, by regulating the peripheral speed.

By the principle of exhaustion the air is removed from the mold before the metal enters it, thereby preventing the displacement of the air in the mold by force.

To draw the molten metal into the mold there must be an exhaustion to more than compensate the amount of atmospheric pressure within the mold, and the force used to bring the metal into the impression is atmospheric pressure induced by a vacuum made by a strong suction pump. The amount of pressure required in the tank to produce exhaustion in the mold for ordinary fillings is about fifteen pounds, which is determined by an air gauge the amount of pressure can be increased according to the exhaustion required for the case at hand.

After heat is applied to obtain sufficient molten condition of the gold in the crucible, the air is immediately exhausted and at the same time the air is drawn from the mold, thus allowing the gold to drop in its place.

The amount of exhaustion to withdraw the air from the mold will depend on the density of the investment, but no difficulty is experienced in drawing the air from any of the inlay investments.

With steam devices, such as shown in Fig. 100, the metal is driven into the mold by the generation of steam upon the molten gold. A very simple and effective device for casting is to use moldine or asbestos in the cap which fits over the flask, a depression being made in the material to form a chamber for the generation of steam.

Fig. 100

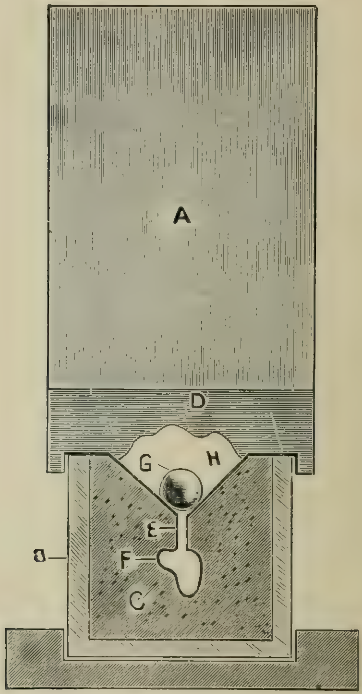


Fig. 100. Steam casting appliance. *A*, plunger; *B*, flask containing investment: *C*, investment; *D*, plunger charged with moldine, asbestos, or clay; *E*, gate or chute opening; *G*, molten gold; *H*, depression made in material *D* for steam chamber. (N. B.—This device may be mechanically adjusted to control the plunger, while casting.)

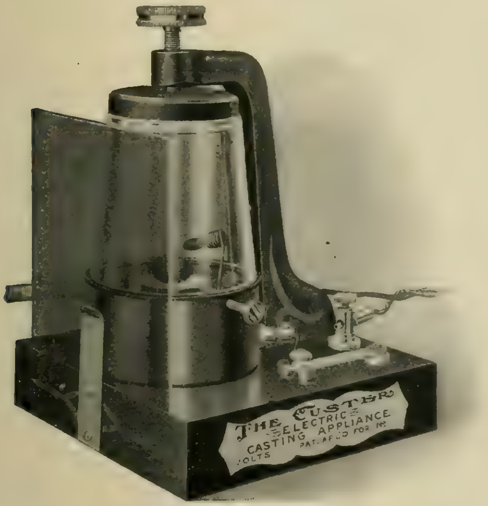
When the cap is charged with this material and saturated with water it is applied to the flask containing the molten gold, the result will be the generation of steam, the casting being obtained by its pressure. The amount of moisture to generate sufficient steam pressure to drive the gold into the cavity is very little, as the pressure is elevated to many pounds to the square inch in coming in contact with such an elevated temperature as that of molten gold.

This means of casting can be accurately controlled, but ordinarily very accurate calculation can be made to produce a facsimile of the wax form. When the mold is ready to cast, the flask is placed in position in the machine; heat can be applied by the use of nitrous oxid, electricity, or the ordinary blowpipe.

Dr. L. E. Custer of Dayton, Ohio, has devised a means of casting, whereby electricity is generated to fuse the gold and the gold driven into the mold by compressed air.

A small arc light is used under a glass dome, and the gold is thus subjected to a high degree of heat in a very small space, and at the proper time a pressure of compressed air is admitted to the receiver which causes the gold to fill the mold.

FIG. 101



This method of casting has the advantage, inasmuch as the operator can control the heat in drying the investment and casting the inlay, and at the same time the case can be seen during the casting process.

The process of casting by this method is thus described: . A carbon crucible is required to melt the gold and also act as a contact for the generation of the electric current. (Fig. 101.)

The carbon crucible is placed cavity downward and the sprue pin is passed through the opening in the carbon, and the wax is allowed to rest about 3-16 of an inch from the surface of the carbon. The index finger guide should be regulated until the lower edge is on a level with the upper surface of the wax.

A small amount of investment is applied over the wax and carbon, extending as far as the base and the upper part of the index finger. After this investment has become sufficiently set, an additional mixture of investment is made to nearly fill the flask. The piece should now be removed from the investment guide and the wire held at the end, and then carefully immersed into the middle of the flask until it is felt to touch the bottom. Care should be taken to cover all the carbon except the crucible depression. After the wax has been burned out, the flask is placed in the center of the appliance, and a nugget of gold is placed into the crucible, large enough to make the filling and enough left to partly fill the crucible.

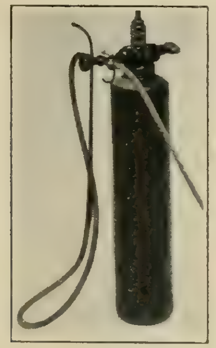
Before casting, the glass dome is placed upon the rubber seat, and the fiber-plate adjusted to the glass; by means of a small thumbscrew at the right of the appliance the carbon is brought in contact with the gold, and by proper adjustment an arc is formed which quickly melts the gold. When the gold becomes in the proper molten condition, the pressure is then applied.

The oxyhydrogen blowpipe, for melting large castings, can be used to advantage, on account of the extreme heat generated by the union of the nitrous oxid and the illuminating gas. This blowpipe is of simple construction, consisting of a tank charged with nitrous oxid and a valve attachment to regulate the flow of the gases. In operating the blowpipe the illuminating gas should be turned on first and ignited and then the nitrous oxid should be turned on gradually, so as to create perfect combustion.

Fig. 102 illustrates a valve attachment devised by Drs. Lane and Seymour of Philadelphia.

Without the valve attachment to the gas tank an ordinary mouth blowpipe can be attached to a rubber hose and then joined to the nitrous oxid tank, the valve of the nitrous oxid is gradually turned on, the blowpipe is held near a jet of illuminating gas and the amount of heat is governed by the flow of the gases.

FIG. 102



This makes a very simple and effective blowpipe for melting high fusible metals.

No difficulty is experienced in fusing the gold, as it easily attains molten condition sufficient to readily flow to all parts of the mold. It is advisable to have a surplus of metal in the crucible, as the casting can be made much more easily, with no danger of a defective inlay. A lower grade of gold may be employed, but pure gold should be used, as better results are obtained. Scrap gold should not be melted in the crucible, as small particles may drop into the chute opening.

The melting of the metal is a very important factor in casting, for there appears to be a much better temperature than the boiling point, and one which will produce better results; in fact, in all casting, such as for making zinc dies, a proper molten condition of the metal is obtained before casting.

In applying the heat, a strong blue flame should be used and directed into the crucible containing the gold; care should be taken not to use a smoky broad flame, as the metal will become oxidized and retard the melting. A flux is unnecessary in fusing pure gold, but when a lower carat is substituted it may be used to aid in the melting process. It is not necessary to be hasty in applying the pressure, for the gold maintains a much better temperature for casting for some time after the blast is withdrawn.

The fusion of gold by pressure has made possible the construction of gold and porcelain crowns, bridges, and even whole dentures. In making bridges and crowns with porcelain facings this method can be used successfully by casting directly on the porcelain, first elevating the investment in the flask to a higher temperature. There is, however, at least quite as much danger of cracking the porcelain as in the soldering process.

The extent to which the casting process can be used, even in forming inlays, is still a question for consideration.

THE UTILIZATION OF THE CASTING PROCESS IN CROWN AND BRIDGE WORK

The casting method, which has been recently introduced in crown and bridge work, has surmounted many difficulties in the processes of their construction. It has considerably simplified the technique of their formation, and at the same time afforded a means whereby much time and labor have been avoided, also producing more accurate results. It is not the purpose of the writer to go into full details in the description of the various situations in which the process can be applied in the mouth; hence, this paper will be confined to a few principles applicable to cases where this method can be used to advantage.

The procedure of making large cast restorations, such as bridge attachments, can be done either by the matrix or wax method; but in cases where great security is required the matrix method can be used to advantage, as a soldered inlay gives greater strength, and also better adaptation of the attachments for retention of the filling.

As the wax is affected by the temperature of the mouth, it is impossible to make extensive restorations entirely in the mouth, but by forming them in parts or units this difficulty can be overcome.

If the abutment fillings are made by the wax method, a somewhat lower carat than pure gold has the preference, as greater strength can be obtained, or in full soldered bridges the abutments can be made of a lower grade gold, depending, of course, on the quality of gold used throughout the construction.

To construct a bridge by this method the abutment fillings are placed in the cavities, and by taking an impression of the parts and withdrawing the abutments a cast is formed therefrom.

With the abutments in position on the model, the intervening structure can be completed for the purpose of soldering, or in the event of the wax dispersion method being used, it can be restored in wax and all of the attachments removed, then invested, and finally subjected to the casting process. Fig. 103 represents a completed bridge, having inlay abutments with post attachments. In extensive restorations it may be necessary to construct it in parts, and, after casting, assembling on the model, solder them together. This will greatly increase the tensil strength of the bridge.

FIG. 103

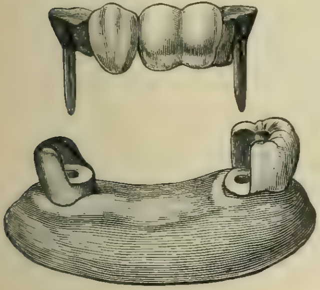
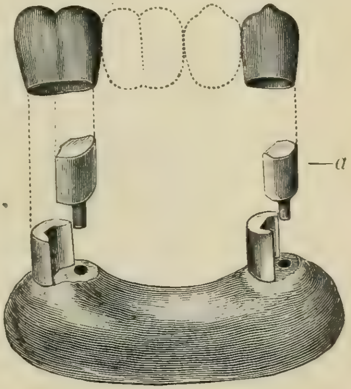


FIG. 104

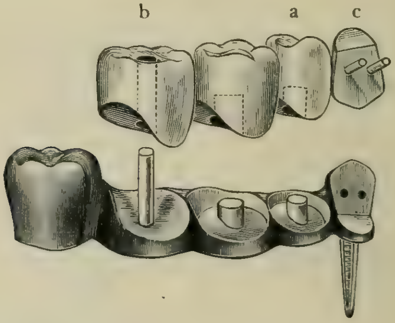


With extensive decay, involving a large part of the tooth, or in case of splitting, involving the tissue beneath the gum margin, inlays can be used to restore this defect, and with great permanency when a bridge restoration is to be made. The inlays are formed for these cavities in the usual way, without contouring, the fillings are cemented permanently in position with the copper cement, as indicated at *a*, Fig. 104, which represents the inlay fillings in position ready to be placed in the cavities; note the manner in which the inlays, when set, will restore the lost tooth tissue beneath the gum. The preparation of a tooth in this way will overcome the difficulty of inserting a band crown over a tooth with considerable loss of wall surface, but no difficulty is experienced when inlay restorations are made, as it allows an easy passage and an accurate fit of a band crown on the tooth.

The inlay process has made possible the application of various designs of porcelain teeth, such as diatoric, tube, dowel crowns, and facings, where it would be impossible to attain such good results in any other way.

The use of diatoric teeth in bridge work presents a valuable enrichment of prosthetic dentistry, on account of their conforming more to the natural appearance of the teeth; another advantage is that, in case of fracture, the teeth can be readily substituted. (Fig. 105, *a*.) A highly valued advantage in casting bridges and crowns in this way is that the porcelain is not subjected to a soldering heat, thereby preventing discoloration.

FIG. 105



Tube teeth can be used in a similar way by mounting the teeth with the tubes in position, in the wax form, and before investing, removing the teeth. (Fig. 105, *b*.) The teeth can be secured on the cast with great permanency by setting them with sulphur or cement.

These teeth make beautiful substitutes, as there is obtained a large restoration of porcelain on the lingual surface to conform more to the natural teeth, with decided comfort to the patient.

The merits of English tube teeth used in the construction of porcelain pieces, as well as in crown and bridge work, have been recognized for some time by our European confrères, while in America the profession have been slow to recognize their superiority over other forms of artificial substitutes, as regards their utility and æsthetic effect.

Facings and saddle attachments, especially for soldered crowns and bridges, prove in many instances very unsatisfactory, on account of their being broken off by the force of mastication, but their attachment to a cast base with cement allows, in case of fracture, an easy means of replacement, especially in fixed bridges, where facings become frequently detached. This method allows an easy means of repair without removing them from their anchorage. In constructing a bridge with these teeth they are fixed in position in the wax on the model, and before casting are removed; graphite points are inserted into the depressions made by the pins, which, after casting, are removed. Fig. 105, *c*, shows a detached facing.

FIG. 106

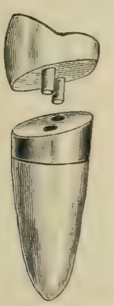
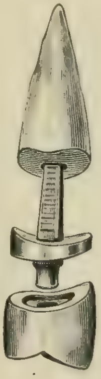


FIG. 107



The plan of casting by pressure on the fused gold can be adopted in making band crowns; a band of 22-k. gold is made to fit the root, and then the wax is formed over the end and cusps carved to shape.

The articulation can be easily had by allowing the opposing tooth to come in contact with it. The band is removed from the root, the wax smoothed and trimmed to shape. The wax should overlap the edges of the band, the sprue is then inserted in the wax, after which the casting can be made. Porcelain saddle teeth can be used on the banded root in the way already described, by cutting the band away so that it will be replaced by the porcelain tooth. The tooth is forced into the wax over the root, the surplus wax is trimmed off, and before submitting it to the casting operation the tooth is removed. In the depressions made by the pins, graphite points are inserted, which will form on the removal after casting a receptacle for the pins of the saddle tooth. This method of forming crowns is clearly illustrated in Fig. 106.

The difficulty of adjusting all porcelain crowns to the end of roots is very effectively overcome by the casting process, as an accurate reproduction of the root can be obtained, thus increasing the stability and permanency of these crowns. A cast base for a crown can be made by applying a small amount of wax over the end of the crown, and then forcing it in place against the root; the wax will fill the intervening space between the crown and root, the surplus wax is trimmed off. After the wax and attachment has been removed from the rest, the crown is withdrawn from the dowel, as indicated in Fig. 107, the sprue wire is inserted on the free surface of the wax so as not to affect the root or crown surfaces.

As has been previously stated, the casting process can be used for the construction of telescope and shell crowns with many advantageous features, as it displaces the unnecessary procedure connected with other methods, such as, for instance, taking impressions, forming models, and also eliminating most of the operation of soldering.

In the procedure of making a shell crown it is absolutely necessary to make a band, for with such plastic material as wax it would be impossible to get an accurate adaptation of the wax beneath the marginal edge of the gum, and at the same time the application of such thin, plastic, and unsupporting material would render it unfit to use in those situations. A band of 28 or 29-gauge, 22-k. gold, should be used in the usual manner of constructing soldered crowns, and 20 or 22-k. solder used to unite the band, then trimmed to the usual form and fitted accurately to the root, and contoured to the proper shape, and the occlusal edge cut so that the band falls short of contact to the opposing tooth, this will allow space for the restoration of the morsal surface of the crown. Fig. 108 shows the position of the band on the root.

Fig. 108

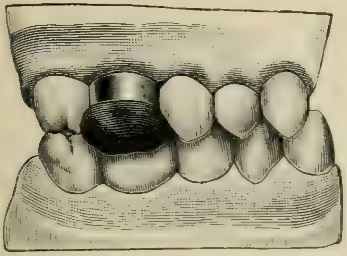
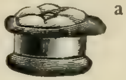
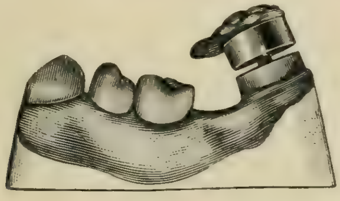


Fig. 109



To restore the occlusal surface, a piece of wax, as used for inlays, is formed to such a size that it will entirely fill the inside of the band and also sufficiently accommodate the occlusion. After the wax has been placed in position in the band, the patient is instructed to bite, this will determine the correct contact. When this has been done a sharp-pointed instrument is applied to the free end of the band and removed from the root; it is advisable at this point to fill the interior of the band with investment, the same used for casting inlays, and allowed to set well before carving the wax, this will allow more deliberation in carving the wax to shape and contour, so that the crown surface will have a typical formation. (Fig. 109a.)

Fig. 110



In those cases where a slight space exists, caused by premature loss of a tooth, an extension can be made on the wax crown surface to make a complete occlusal surface. Fig. 110 shows the crown and wax extension.

FIG. 111

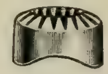
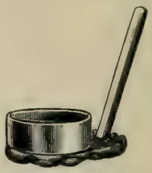


FIG. 112



In order to secure greater contact of the cast to the gold band, the free edge of the band can be cut so as to have a rack edge and bent inwardly according as the case will allow. Fig. 111 describes the manner of shaping the band. Fig. 112 shows the sprue wire attached to the wax form ready for investment.

In some instances where there is a thin layer of wax between the crown and the root, a small portion of the lingual surface of the tooth can be ground away. (Fig. 113a.) This will give a greater body of wax for the insertion of the sprue. Fig. 113b represents the wax attachment and sprue in position ready to be invested for casting. For these cases platinum gold alloy has the preference, as it

FIG. 113

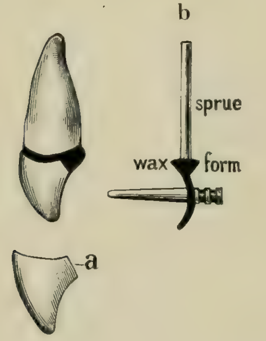
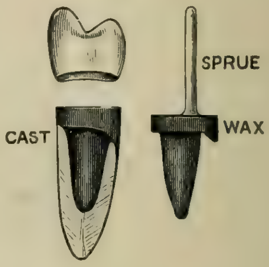


FIG. 114



has greater strength than castings made of pure gold, and also possessing the non-oxidizing property.

The advantages gained by adapting the cast base in preference to grinding the crown, so as to obtain root contact, are that greater accuracy is obtained, thereby increasing the stability of the crown, also considerably increasing the range of application, especially in irregular peripheral root formation.

An exceedingly valuable adjunct in the construction of crowns is that badly affected roots, that otherwise could not be successfully used, are restored to usefulness. Take, for example, a badly affected root where the decay has considerably enlarged the root canal, a wax restoration can be had of the part and a casting obtained by the wax dispersion method or by packing moss fiber gold in the cavity, removing it and then investing in sump, after the usual method of forming moss fiber inlays. In all such cases, as well as other extensive restorations, pure gold is prohibited, but fusible metal, like Weston's, can be used to advantage, the expense being trifling and the results equally good. In setting the casting, preference is given to copper cement, as it is protective against recurrence of decay. Such a cast restoration is shown in Fig. 114.

Mounting shell crowns over such prepared roots will increase their stability and permanency. Many roots would be condemned to the forceps if these methods of restoration could not be employed.

MAKING BASE PLATES OF ALUMINUM, FUSIBLE METAL, AND GOLD BY THE CASTING PROCESS

As it has been stated, the process of casting aluminum and fusible metal plates under pressure has long been known in the prosthetic art, but it was not known until after Taggert had introduced his process of casting fillings of pure gold, that gold could be subjected to the same process, whereby whole or partial plates could be successfully cast.

The casting process, as applied to making aluminum plates, introduced some years ago by Bean, Zeeler, Carrol, and Moffitt, was soon abandoned by the profession, as the aluminum produced at that time was not made of sufficient purity to admit of it being used for making cast plates, and resulted in complete failures on account of the impurity of the metal, as the metal became disintegrated under the influence of the fluids of the mouth; but recent improvements in the methods of obtaining it have rendered its production of extreme purity, to be more applicable for casting; in fact, as the metal is now supplied, it can be used in the process of drop forging.

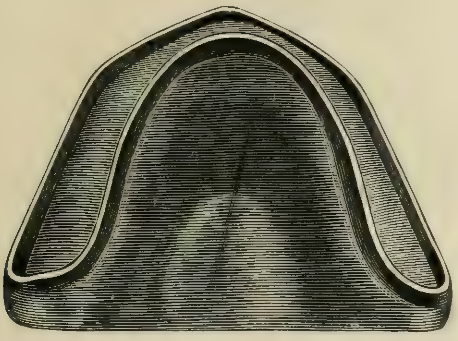
Cast aluminum work, as produced some years ago, is thus described by Dr. Moffitt: A suitable flask with gate or tube is used to pour the metal therein. The model and investment are made of equal parts, by measure, of ground silex and plaster. The restoration to be made, such as a plate, is modeled in pure paraffin, and the gates should be made of the same and arranged as for pouring any fusible metal. The flask is heated so that the paraffin runs and burns out, leaving a vacant mold which is ready to receive the molten aluminum, which is melted in a sand crucible kept covered with paraffin, to prevent the air coming in contact with it. After the investment in the flask is heated to the temperature required, pour it, care being taken to have the aluminum well covered with paraffin, and after the metal is in a suitable condition for casting, a plunger is pressed into the gate receptacle and the result is the metal is forced into the mold. Thus, it will be readily seen by the foregoing, that the principle of casting aluminum and fusible metal plates at that time was not unlike those now in vogue.

In making dentures of aluminum, it is possible to cast upon the teeth, but the practical way to secure the teeth on the plate is with rubber attachment. If castings are made with the teeth in position, it is advisable to carve the wax on the model so that the least possible porcelain is inclosed by the metal casting; this will lessen the possibility of the teeth becoming cracked by the shrinkage of the metal.

There are some advantages of the cast plate as compared with the swaged one, namely, that more accurate adaptation of the metal to the model can be had and, especially in undercut cases, it can be directly cast on the model. Also, in view of the fact that the casting can be of varied thickness, according to the strain to which the denture is subjected, the rigidity of the plate can be greatly increased by carrying a rim of metal on the lingual side a short distance from the teeth, as well as on the outer side of the plate. Then, too, another feature with the cast base is that the anchorage for the teeth can be secured much easier and no danger of causing distortion of the plate.

The technique of casting aluminum and fusible metal plates is as follows: An impression is taken in the usual way, and a cast is obtained of the same material as the investment (Fig. 115), then the plate is waxed to shape in the usual way, excepting the addition made for attaching the rubber, such as loops, dovetail extensions or spurring made in the wax, and the wax rim is made on the inner and outer side of the plate.

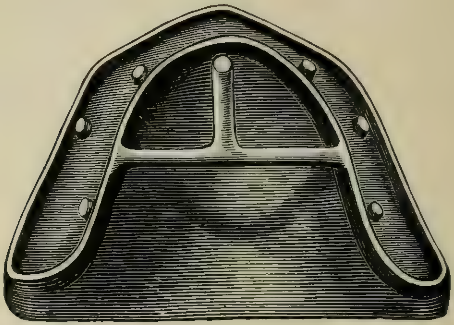
FIG. 115



The gateways or chute openings are made of wax as well, and arranged in suitable positions on the plate, then radiating from one common center — the chute opening should be about the size of No. 9 or 10 gauge wire. Fig. 116 shows the plate waxed to form with sprue attachments ready to be invested. The size flask to select will vary according to the extent of the cast, and the investment should be the same as used for the model. Excellent investments for this purpose can be had from any supply house.

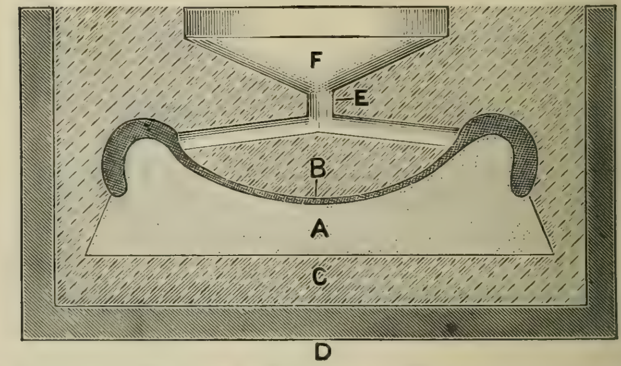
Dr. Robert Seymour, of Philadelphia, recommends a much coarser investment than the kind used for inlays, in the form of three parts of gravel to one of model plaster, the red bird-gravel can be had at drug stores. Before investing the model, it should be saturated with water, so that the surrounding investment will firmly unite with it. The case is then invested and the investment first smeared over the

FIG. 116



whole surface of the plate, care being taken to get the investment well around the gate opening. The case is allowed to sink in the

FIG. 117

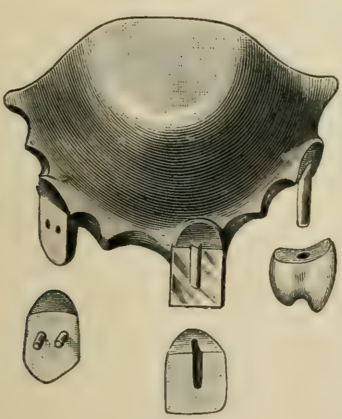


A, model from impression; B, mold; C, investment surrounding mold; D, flask; E, ingate or git opening; F, crucible.

investment, leaving the main gateway partly exposed. Fig. 117 will clearly show the position of the case in the flask. After the investment has become sufficiently set, a crucible depression should be made around the gateway, according to the amount of metal required for the casting, and the depth will be governed by a mark made on the sprue about one-fourth of an inch from the gateway; in this way the molten metal is placed near the position where it is to be forced.

The case is now ready for the removal of the wax, the flask should be first placed over a low heat, to avoid cracking the investment, and then it should be gradually turned on and increased to a much higher temperature, and continued for a longer time, on account of a greater bulk of investment and a greater amount of wax to dispel from the mold. After the investment has been thoroughly heated it is placed in position in the casting machine, a sufficient amount of the ingot of metal is placed in the crucible and then subjected to the heating process, which can be easily done with the ordinary blowpipe, as the metal melts at comparatively low temperature (about 1160°F.). No flux is required, such as borax, as it has a deleterious effect on the metal, and before ready to cast the metal should be stirred with a pine stick to get the entire mass in a thoroughly molten condition. When the metal is in a proper molten condition, the pressure is applied and the casting made.

FIG. 118



Owing to the specific gravity of aluminum, which is 2.56, it is made unfavorable under ordinary conditions for casting, but when subjected to sustained pressure this difficulty is overcome. It is well to avoid too great an amount of metal remaining in the crucible after casting, for on cooling a large bulk of metal may have a tendency to draw it away from the mold.

A sustained pressure on the molten metal will lessen the contraction of the metal, also have a tendency to increase its density; the pressure should be left on for fully one-half minute. After the casting is allowed to cool it is removed from the investment, the teeth are arranged and secured with rubber attachments.

Gold and fusible metal plates are made in a similar manner. Fig. 118 illustrates a base plate of gold ready to receive the porcelain teeth.

In the case described, it shows the possibility of this process, by the adaptation of various forms of artificial teeth, such as English tube, and Steele's detachable and other facings.

Dr. Solbrig, Paris, France, strongly recommends the use of platinized gold, which is known by another name of clasp metal, for casting plates.

Under the process of swaging this metal, it is impossible to give it the proper shape on account of its springiness and resistance, for if subjected to too great a force the rugies of the mold would be battered, but by the process of casting by pressure allows the casting to be done without destroying the delicate lines of the mold.

AMALGAM INLAYS

Where large restorations are made in the posterior teeth with amalgam, the inlaying principle of filling can be used, in some cases, to better advantage by constructing amalgam inlays, as by this method it allows an adaptation of such material to a cement-lined cavity, also giving better security and at the same time a greater range for contouring without endangering its stability.

The advantage of using amalgam in this manner is, over the ordinary way, that a tin-lined filling is used in its construction, the tin possessing the property of preserving tooth structure.

The technique of the method, as applied to the formation of the inlay in the various stages of construction, is very much the same as for gold inlays.

After the cavity is prepared in the way adapted for gold inlays, tin foil, about 60 gauge, is burnished into the cavity, the foil overlapping the marginal edges, care being taken to have the foil well applied to the cavity edge. On account of tin-foil being such a soft material it can be applied very easily into the cavity; providing one thickness is not sufficient an additional layer of foil can be used by folding them together. These pieces can be held intact with varnish, such as gum mastic or sandarach, the former is more preferable as it is more adhesive; the varnish will prevent the mercury from being absorbed through the tin-foil. After obtaining a matrix of the cavity in this way, modeling compound is inserted on a suitable impression tray, warmed and pressed over the foil in the cavity, the compound is chilled and then removed, the matrix readily coming away from the cavity. From this a model in plaster is obtained, the plaster is worked very carefully into the matrix with a small spatula or a camel's-hair brush, and then immersed in a small amount of plaster; after allowing it to set, the compound is removed, leaving the model with the tin matrix in position.

Sometimes it may be necessary to take an impression of the cavity and obtain a model by the indirect method, then the matrix is applied to the model by thoroughly burnishing it to all parts — the matrix should be trimmed to extend about two lines over the marginal edge of the model. The matrix is now thoroughly varnished; letting it dry enough so that it will become quite sticky, for on applying the amalgam it will readily adhere and the gum solution will prevent the mercury from penetrating into the tin.

In mixing the amalgam for this purpose, all excess of mercury is removed to prevent it affecting the tin; the amalgam is thoroughly worked into the model, and especial care should be taken to condense it well against the marginal edges, the contouring can be made according as the case demands. The amalgam inlay is then placed aside for several hours until it becomes thoroughly set. The cementing and polishing the inlay in the cavity is much the same as for gold inlays, the finishing disks should revolve in the direction of the marginal edge.

FIG. 119

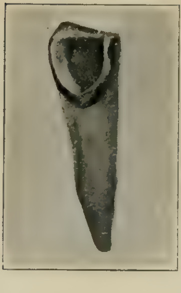


FIG. 120

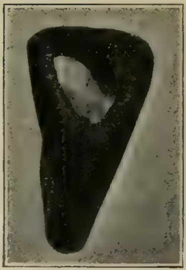


FIG. 121

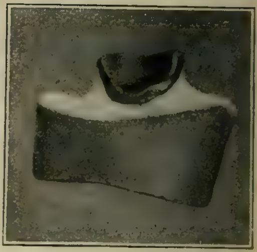


FIG. 122

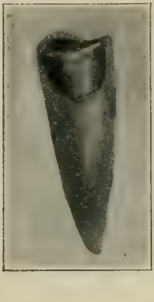


FIG. 123

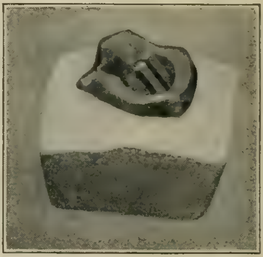


FIG. 124

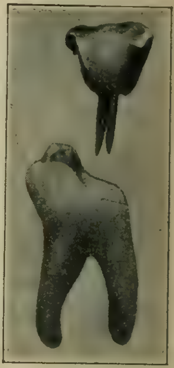


FIG. 125

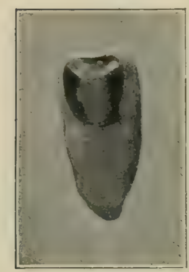


FIG. 126

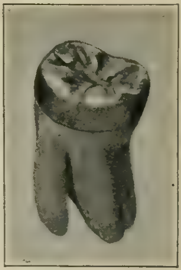
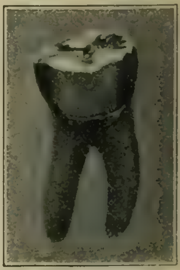


FIG. 127



In badly broken-down teeth, involving the morsal surface the cusps can be restored very artistically and contoured to their natural form. The retention for this class of fillings is the same as used for other gold inlays, by the use of pins, posts, or loops; or retention can be held by drilling away the amalgam on the cavity portion of the inlay, making a hollow depression for security.

In deep cavities extending into the pulp chamber, post attachments can be made to the inlay by allowing them to extend into the root canals; to secure them to the inlay in this manner the matrix is applied to the cavity, the posts or pins are forced through the matrix into the roots, leaving the free end to extend well into the cavity portion. An impression is taken with these attachments in position and removed from the cavity, a cast is obtained by pouring plaster over the matrix and its attachments, or, in case the matrix does not extend to the full depth of the cavity, pins can be inserted into the matrix after its removal from the cavity, by drilling holes into the matrix into the compound, then the pins are inserted in place and extend from the matrix according to the depth of the intervening material. To obtain the benefit of a tin-lined cavity, especially where security cannot be obtained excepting by making undercuts, the tin foil can be burnished into the cavity, and then the cavity filled with amalgam in the ordinary way.

Amalgam restorations modeled by L. C. Elkins, D. D. S. Fig. 119 showing a tin-foil matrix burnished in cavity; Fig. 120, matrix invested in compound; Fig. 121, matrix transferred to model; Figs. 122, 123, 124, 125, 126, 127, showing means of retention and restoration of some cases.

In conclusion, I may state that, by the advent of filling teeth by the gold inlay system has increased our selection of filling materials, and has also marked an advancement in dental practice for which the profession and public may well be grateful.

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